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THE METAL INDUSTRY

WITH WHICH ARE INCORPORATED

THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER:

ELECTRO-PLATERS REVIEW

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A MONTHLY JOURNAL RELATING TO THE METAL AND PLATING TRADES

CONTENTS, PAGE 469 DIRECTORIES, PAGE 75 WANT ADS, PAGE 84 INDEX TO ADVERTISEMENTS, PAGE 96

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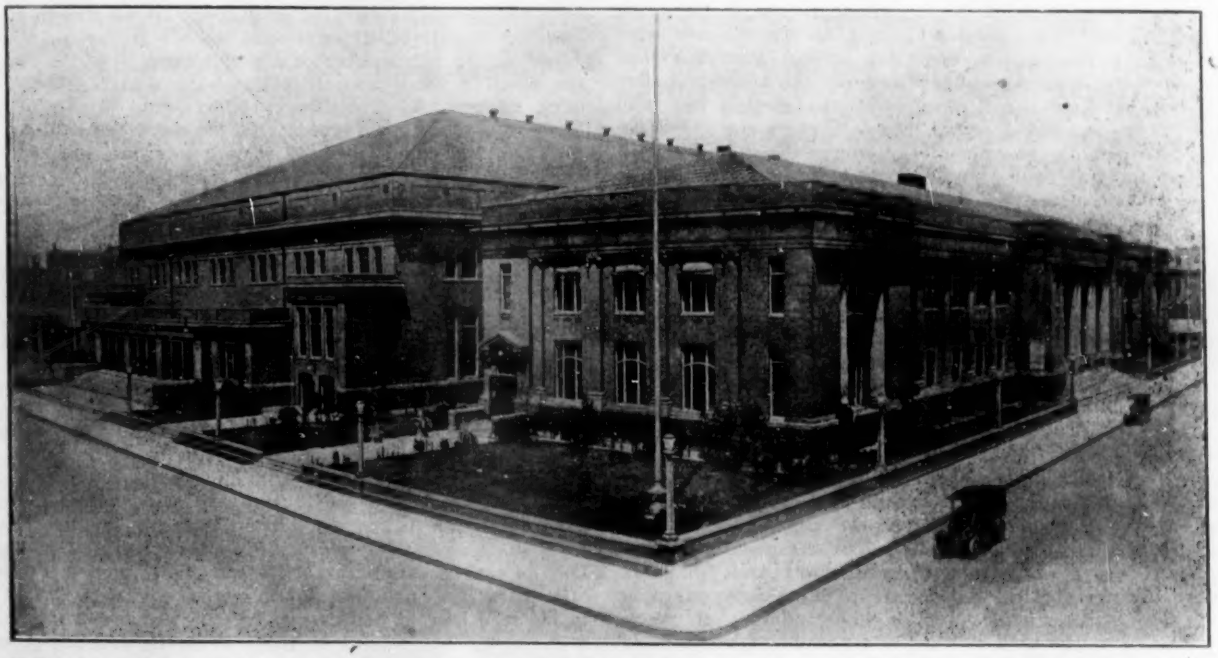
ELECTRO-PLATERS REVIEW

Vol. 16 NEW YORK, OCTOBER, 1918 No. 10

THE ALLIED METAL TRADES CONGRESS

A Brief Report of the Proceedings of the Joint Convention and Exhibition of Foundry Supplies and Appliances Held at Milwaukee, Wis., October 7 to 11, 1918, by the American Foundrymen's Association, the Institute of Metals Division of the American Institute of Mining Engineers, the Iron and Steel Section of the American Institute of Mining Engineers and the American Malleable Castings Association.

The keynote of the convention of the Allied Metal Trades Association, which took place in Milwaukee, Wis., the week of October 7 to 11, 1918, was patriotism. This was shown not only to a marked degree in the meetings of the four great societies which met in joint convention, but also in the mammoth exhibition which was staged in the Milwaukee Auditorium, the largest building of its kind in the United States.



THE AUDITORIUM AT MILWAUKEE, WISCONSIN, WHERE THE ANNUAL CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION AND THE INSTITUTE OF METALS, DIVISION OF THE AMERICAN INSTITUTE OF MINING ENGINEERS, TOGETHER WITH THE CONCURRENT EXHIBITION OF FOUNDRY SUPPLIES AND EQUIPMENT, MACHINE TOOL AND ACCESSORIES, CONDUCTED UNDER THE AUSPICES OF THESE TWO ORGANIZATIONS, WAS HELD OCTOBER 7-11, 1918.

THE OPENING SESSION.

The convention opened in Plankington Hall in the Auditorium on Tuesday morning, October 7. At this meeting the delegates of the various societies were welcomed to the State and given the freedom of the city by Governor E. L. Phillip, who said "That he believed the end of the war would not bring a stagnation of industry. Many things have been left undone which will have to move forward after peace. The world is hungry and needs materials and will look to this country for them. Railroads will need many improvements and much building, now at a standstill, will be continued."

The Governor's address of welcome was responded to by Benjamin D. Fuller, president of the American Foundrymen's Association, who, after thanking the Governor, recounted briefly the activities of the association during the past year and the aims for the coming one. Mr. Fuller pledged anew the utmost support of the organization of which he is president to the extent of 100 per cent in the prosecution of the war.

Mr. Fuller was followed by Secretary A. O. Backert, who read his annual report and also a stirring message from Past President Captain R. A. Bull, who is now in France connected with the Ordnance Department.

A MESSAGE TO A. F. A. MEMBERS FROM THE WESTERN FRONT

By CAPT. R. A. BULL

To the Members of the American Foundrymen's Association:

The chairman of your committee on papers has written across the seas asking me to forward greetings appropriate for your convention to be held within a few weeks at Milwaukee. Your secretary has seconded the request. I am much indebted to both of these gentlemen for the co-operation given me when the expanding activities of the association made heavy demands upon its officers, and I, therefore, find it difficult to refuse them. But my compliance is mainly due to a desire to testify to Uncle Sam's excellent care of his soldiers, and to add, if possible, to your pride in the morale of our fighting men.

If I occupied with the American Expeditionary Eorces a position of exposure to dangers and hardships, or if I performed a relatively important function in the military organization in France, I would hesitate to voice my sentiments, which in either case might be mistaken for self-praise. At the outset let me confess that since arriving in France in May of this year, I have been a perfect stranger to unusual hazards of life and to physical discomforts.

Many things must be done by the noncombatant branches of the American army in France, back of the battle lines, in what is called the Service of Supplies. Those who are doing this work make no pretensions to performing the tasks of heroes, and feel the more keenly their great obligations to their comrades at the front because of their own assignments in the rear. Many of them have seen, as I have, what a wreck of the yet living body can be made by the enemy's bullet, shell, bomb and gas; have witnessed the fortitude of wounded men under intense suffering; have observed the morale of our soldiers detained for treatment in the rear, keenly anxious to return to the trenches to settle the score with Fritz. Seeing all of this, and realizing how effectively he is hitting the Boche line, my respect for the Yankee fighting man, whatever may be his rank, is supreme. Many of the youths who man the guns, who carry the cold steel over the top, who bridge the streams under the enemy's fire, who minister to the wounded where they fall, are your own kinsmen. How proudly you must bear yourselves in the knowledge that those of your own flesh and blood are bearing this burden! And if perchance those whom you love, must make the supreme sacrifice, how glorious a heritage their dauntless courage will leave to you!

The things that are worse than death include subjection to Prussianism, with all the atrocities of which it is the parent. I have talked with some who witnessed the horrors perpetrated by the Kaiser's minious upon the enslaved inhabitants of those sections of France and Belgium which for some time have been occupied by the enemy. I saw, in the critical days of the supreme effort made by the German army to capture Paris, the pitiable condition of old men, women and little children, fleeing from the wrath of the relentless Hun, carrying on their backs and in their arms all of their earthly possessions they could save. I cannot forget the expression of intense suffering on the faces of the women; of sorrow and bewilderment on those of the children, whose glances at every stranger seemed to ask the reason for it all. I have been proud of my nationality to learn how our own Red Cross had comforted many of those unhappy refugees. Every branch of the service has when possible taken a hand in relief work. One little boy has for some time called his home an American camp in the zone of advance where his fine, manly appearance in an olive-drab uniform drew my attention. I learned that U. S. engineer troops had discovered him at his daily task of getting subsistence from the camp garbage cans. Charlie was a homeless, friendless war waif of eight years. His father had been killed and his mother had died. He had been adopted by the engineers who found and left him in the efficient care of Y. M. C. A. representatives until the return from the front of his big-hearted foster-brothers.

It is always comforting to know that our own are in good hands. You have been informed through many channels that the American soldier in France is well cared for. I want to add my endorsement. The medical corps is zealous in its care for the sick and wounded, and in sanitary work. The strictest attention is given to drinking water. Troops quartered in barracks are housed with special regard for ventilation and cleanliness. In the camps in France where I have been stationed there are excellent bath houses, better than those at the camp in the states where I was formerly on duty. The quartermaster corps is rendering very efficient service in procuring and distributing clothing and other supplies. It sells tobacco and candies to the soldiers at very low prices. Twenty cigarettes of a popular American brand may be obtained for 5 cents. In most localities, and where conditions permit, the army messes have the most wholesome food, in liberal quantities, well prepared. There is no lack of sugar, wheat flour or meat in the American Expeditionary Force, mainly due, as we realize, to the cheerful self-denial of the folks back home. Just as rapidly as our troops arrive do their supplies seem to precede them.

The American Red Cross is surpassing all its magnificent traditions. It is found everywhere in France, seeking to serve, leaving with those who have felt its influence, grateful recollections that will never fade. Its chief function of caring for those selected by fate as the victims of the enemy's instruments of torture and suffering is being performed with the greatest skill and dispatch, in superb defiance of danger to those who minister. The inspiring devation of its hard-working, consecrated men and women will constitute one of the most glorious memories of this conflict. Linked as its activities are with every patriotic home in America, its appeal to the sentiment of the Yankee in France makes it his ideal of devoted service that never fails.

The needs of the "Armee Americaine" have been thoughtfully considered apart from purely physical comforts. At the convalescent and rest camps every available means is supplied for cheerful, wholesome entertainment and recreation, with splendid effect on the spirit of the men. By long odds the greatest single factor in maintaining, day in and day out, the morale of the American soldier is the Y. M. C. A. There is the atmosphere of a democratic club, the resort of the finest type of man that has been created—the Yankee buck private. The nightly entertainments in the "Y" huts back of the line, the comforts in the advanced stations along the line, the single idea of service and the spirit of good cheer and clean living actuating this and similar organizations bridge the enormous gap between the home in America and the camp in France as no agency of different character could possibly do. The men and women who wear the red triangle have exhibited in many cases a heroic and, in general, a sympathetic spirit of helpfulness that makes an irresistible appeal. No mollycoddle tendency exists in the Y. M. C. A. in France to detract from its drawing power among red-blooded men. I have heard the "Y" leader at a Sunday night sing-song preceding a prayer and a soulful talk, conduct the singing of "Hail! Hail! the Gang's All Here. What the Hell Do We Care Now?" with as much feeling as accompanied "Onward, Christian Soldiers," which followed it.

Some may wonder if the injunction to right living reaches the hearts of men whose business it is to kill Germans. I have a canteen picked up at the front, which once belonged to a doughboy who presumably made the great sacrifice. On the canteen are scratched the soldier's name and numerous characters including these words: "If a man ain't true to his wife how in hell can he be true to his country?" That is the essence of fidelity to trust, domestic and public which I believe to be one of the outstanding characteristics of your plain-spoken, tin-hatted representatives in France.

Mention of the spirit in your army overseas is incomplete without reference to the women at home. The typical American in France has created in his mind a halo about them. In his leisure hours he takes from the treasure-chest of his memory those American women who are especially dear to him, who are courageously keeping the home fires burning. Figuratively he places these heroines before him on the pedestals erected for them in his thought through the knowledge of their cheerful sacrifices. He sees them industriously making socks and bandages; conserving every grain of sugar and every ounce of flour; anxiously scanning the published casualty lists. He hears them praying to the Author of Liberty for the safety of him, its defender. And when he has

received, as he invariably does from this mental journey home, the inspiration that no one now living in America can appreciate, he applies himself vigorously to the job of killing Huns with a solemn vow that *his* womenfolk in this or any other generation, shall never suffer at the hands of war-mad Germany what has come to the women in France and Belgium.

Tribute has been paid to the splendid work of our allies countless times. Appreciation compels me to mention it at the risk of seeming to repeat something which needs no emphasis at my humble hands. I had the honor, a few days ago, to meet an elderly French general who has received 11 wounds in this war. One of them left an ugly scar on his chin, another a deep depression in his skull. His right arm is gone at the elbow. The General, in fluent English, with the ardor of youth, discussed the war at length with a group of junior American officers. His analysis of conditions was keen. His praise of our troops was emphatic. His modesty and genuine friendliness were superb. This battle-scarred old veteran is still rendering valiant service. His spirit is like that of the typical French soldier today. After four of the most trying years through which any nation could pass, the French maintain their poise and their vigor to a degree that is amazing. Unstinted praise is demanded by such an inspiring demonstration.

The British soldier is entitled to our admiration without bounds. He has been a complete failure—as his own press-agent. As a tenacious, courageous bull-dog who quietly fights on until he or his adversary is done for, he merits our highest esteem. John Bull's allies are under an enormous obligation to these reticent chaps who went quickly from the British Isles and Colonies to the rescue of Belgium and France and who, without any fuss, have been doggedly seeing the thing through. Do not forget the debt of America to the British navy. And remember that the British empire has to date furnished, according to press reports, about eight and one-half millions of her very best men to save democracy.

I can appropriately testify to the earnest appreciation of the men in the American Expeditionary Force for the splendid work being done by the industrial army in the states. Through the appreciated enterprise of certain journalists we receive daily European editions of several well-known American and English papers. From these and the admirable weekly paper of the American Expeditionary Force, called The Stars and Stripes, we are kept posted as to many developments concerning the war in our own native land. We see in France now many of the results of the labor at home. We know vastly more will follow as quickly as human ingenuity and untiring energy can bring them here. Your men in France are thrilled by the progress in shipbuilding, by the passage of the "man power" bill. Our location has not distorted our sense of perspective. We realize that millions of men and women and many children must labor in America that the vast numbers of her sons in Europe may have the means to finish their task quickly. And we regard those who are unceasingly rendering this service at home and who are best qualified for it, as equal in devotion to duty with those who wear the overseas cap.

The members of the American Foundrymen's association and the other organizations co-operating with it in the 1918 convention have before them a task of huge proportions in doing their full duty at this time. Anyone who knows them as I do, knows they will fulfill every obligation, and need no urging. You realize that every moment of time or ounce of energy wasted in the United States increases the casualty lists of our army. The allies are steadily pushing toward Berlin those who would have made it the capital of a conquered world. This progress can only be speeded up by the most vigorous co-operation at home with that of those whose job it is to shoot and cut their way through the resisting lines of the enemy. No sacrifice that we can make is comparable in the slightest degree with that being made every hour in France by our men whose blood is bathing her soil. Those who are going through hell for you and me are confidently looking toward America for that supreme manifestation of speed and efficiency of which her people are capable. Their belief that they are being backed up to the limit at home is as steadfast as is their faith in God. Being near to but not of these heroes without credentials from them but voluntarily speaking for them as an individual, I salute you as brother-patriots, whose sole purpose now is the preservation of liberty for our own and future generations.

(Signed) R. A. BULL.

(Self-censored. R. A. Bull, Capt. Ord. Dept., A. E. F.)
France, Aug. 29, 1918. (Mailed Sept. 3, 1918.)

The next speaker was E. D. Brigham, manager of the ore, coal and grain traffic of the United States Railroad Administration, who spoke on co-operation between the railroad administration and the metal working industries. Mr. Brigham supported the Governor's views and said that materials were now needed in every quarter for war purposes, but after peace the increase in rates would make improvements possible and the amount of materials needed would be stupendous.

A spirited appeal was sent to the metal trades by Chairman Hurley of the United States Shipping Board, who urged manufacturers to get ready to increase their export trade. He said the Government was turning out many ships, but that they would be of little use after the war unless American manufacturers increased their exports. He asked further for the appointment of committees to take up the matter. Each of the four societies which comprise the Allied Metals Congress have named committees with instructions to investigate the subject.

V. E. Minich of New York, in a ringing and emphatic speech, offered a resolution to be telegraphed to President Wilson assuring him that the huge metal industry is back of him to the finish in his efforts to win the war and that nothing will be left undone to accelerate the manufacture of needed munitions and materials. Mr. Minich said also that "The German peace offer did not have the stamp of sincerity and that the Government should be given renewed support and assurance that the people and business interests were not ready to stop fighting until the enemy makes an unconditional surrender.

THE RESOLUTION:

"That every resource of these allied metal trades be and is again pledged to the government, not only in the production of materials for the conduct of the war, but for the accelerated manufacture of these materials to enable the government to greatly intensify its prosecution of the war and to bring about a speedy and crushing defeat of the enemy that will lead to his abject and unconditional surrender."

The resolution was adopted unanimously and was sent off with an inspiring burst of cheers.

The activities of the Army Ordnance Department, especially as applied to foundry matters, was discussed in an able and exhaustive manner by C. S. Koch, Cannon Section Production Division, Ordnance Department, Washington, D. C. His paper disclosed with a startling array of figures the enormous amount of material needed and absorbed by the Ordnance Department. It is well worth perusal in that it would set at rest fears that are and have been entertained by some as to the way the money of the people has been spent.

Following Mr. Koch, came Major Frank D. Gilbreth with an address of "Modern Methods of Transferring Skill." Major Gilbreth described at some length the methods used by the Government in drilling the "rookie" in the process of producing a finished soldier. The address was illustrated by means of remarkable moving picture films which the Major declared embodied the one best way of providing the necessary instruction. This method, he said, has been adopted by the Government at all of its training camps.

INSTITUTE OF METALS DIVISION.

The first session of the Institute of Metals Division of the American Institute of Mining Engineers was held in Kilbourn Hall of the Auditorium on Tuesday morning, October 8. This was the first meeting of the American Institute of Metals since it became the Metals Division of the American Institute of Mining Engineers. The meeting was called to order by the chairman of the division, W. M. Corse, of the Ohio Brass Company, who read his annual address. The address was as follows:

CHAIRMAN CORSE'S ADDRESS.

The most important event of our year is the affiliation of our Institute with the American Institute of Mining Engineers. It gives us the opportunity of meeting twice a year and of associating in at least one of these meetings with men representing the producers of the metals that we all use.

The opportunity to study the raw material end of our business has not been afforded at our meetings heretofore and should prove of great value to our members. The affiliation with the American Institute of Mining Engineers gives a permanent headquarters in New York City, the use of the large engineering library in the Engineering Societies' building, and a permanent secretarial and editorial staff. We, on the other hand, must do our part in making the meetings of our division a success, both by writing papers and by participating in the discussions.

I think our meetings are generally considered to be excellent from a discussion standpoint. Let us endeavor to maintain this feature in our divisional meetings and interest in them men who are informed on subjects related in any way to the non-ferrous metal industry.

In these war times it is particularly necessary to prepare ourselves for the reconstruction period to follow by perfecting our manufacturing processes and studying the most efficient methods of transacting our particular business. Any society whose aim is educational has a duty to perform in this respect, and as we represent the non-ferrous alloy and metal industries, it is incumbent on us to see that we are informed of the best and latest practice and furnish the medium for its wide dissemination. The need for maximum production is so great at the present time that it is difficult to find time to do research work, but it seems to be very necessary that we set aside some money and time in order that we may be ready to produce at the lowest cost and in the most efficient manner when the times become normal. Our efforts in this direction, through our co-operative work with the Bureau of Standards, have been halted during the war, but it is our intention to continue this co-operative work as soon as practicable.

Our Institute has already been the means through which much help has been rendered to the Government, and our present affiliation puts us in a position to be of maximum help in this respect.

Many of our members have rendered splendid service in technical capacities to the United States, for which we are very glad. It gives me pleasure to see the generous manner in which our men have responded to any calls made on their time and experience. Let us resolve to make our Institute of Metals Division more of a power in the Metal world and to carry on our meetings in such a way that the American Institute of Mining Engineers will feel that they have acquired an energetic and useful member in their household.

I want to thank the membership for the co-operation they have given me during the year and for the splendid response to our new plan of organization.

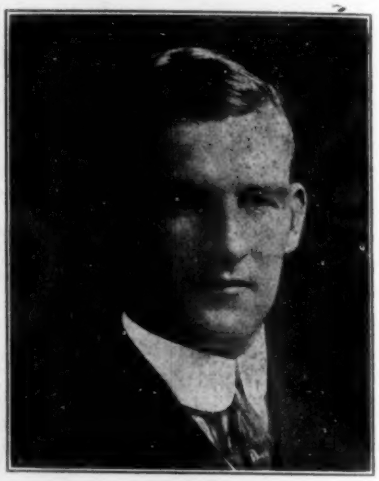
May the Institute of Metals Division of the American Institute of Mining Engineers be a worthy member of the metallurgical family of which we are now a part.

The report of the secretary, F. L. Wolf, followed that of the chairman and was as follows:

OFFICERS OF THE INSTITUTE OF METALS DIVISION FOR 1918-19

W. M. CORSE,
Chairman.

F. L. WOLFE,
Secretary.



W. B. PRICE,
Vice-President.

SECRETARY'S REPORT.

The membership of the Institute of July 1, 1918, showed an active membership of 337 and an associate membership of 49, making a total of 386.

In the active membership are included the corporation members, each corporation having three members.

The most important feature of the past year has been the affiliation of the Institute with the American Institute of Mining Engineers. The advantages of this union were explained in the letter which was sent you on April 8.

We retain our identity, elect our own officers, as heretofore, hold our meetings as before at the same time and place as that held by the American Foundrymen's Association and, in addition, a meeting in February, which is held at New York, with the American Institute of Mining Engineers. By this affiliation we secure all the advantages which are offered by one of the largest and best-known scientific societies.

A glance at our program will show that an excellent program has been provided by the Papers Committee, of which Dr. Paul D. Merica is chairman.

The following is the standing of the books on October 6, 1918:

RECEIPTS.

Cash on Hand, July 1, 1917	$740.04
Dues	3,610.50
Volumes	783.96
Emblems	21.00

Interest	$2.00
Refund from Rumford Press	19.25
Rentals of Electros to METAL INDUSTRY	5.00
A. F. A.	250.00
Miscellaneous	.37
Total	$5,432.12

DISBURSEMENTS.

Printing, Including Postage	$3,202.98
Postage	114.15
Salaries	1,025.00
Office Supplies	19.91
Refunds	50.25
Bond	2.50
Insurance	37.62
Convention	236.10
Miscellaneous	25.49
Exchange	7.85
Cash on Hand, October 5, 1918	710.27
Total	$5,432.12

"THE METALLOGRAPHY OF TUNGSTEN," by Zay Jeffries,[1] with a discussion by Sir Robert Hadfield,[2] engaged the attention of the meeting until its adjournment.

WEDNESDAY MORNING, OCTOBER 9

The second session of the Metals Division was opened on Wednesday morning by the reading and discussion of the paper, "THE CONSTITUTION OF THE TIN BRONZES," by S. L. Hoyt. This paper was followed by a paper, "NOTES ON BABBITTS AND BABBITTED BEARINGS,"[3] by J. L. Jones.

H. J. ROAST,
Vice-President

W. H. Bassett then read and briefly discussed two papers by S. Skowronski. These papers had been presented before the American Institute of Mining Engineers at their Denver meeting in September, 1918, and were "OXYGEN AND SULPHUR IN THE MELTING OF COPPER CATHODES,"[4] and the "RELATION OF SULPHUR TO THE OVER POLING OF COPPER,"[5] with a discussion by Philip L. Gill.

The reading of these papers was followed by A. F. Braid, who read a paper on "CARBON FREE MANGANESE AND MANGANESE COPPER," with special reference to the use of manganese as a deoxidizer. This paper is published in this issue of THE METAL INDUSTRY.

SYMPOSIUM ON CONSERVATION OF TIN.

This symposium was participated in by the following:

D. W. G. Thompson, paper read by W. A. Cowan, both of the National Lead Company, New York.

G. H. Clamer, Ajax Metal Company, Philadelphia, Pa.

C. M. Waring, Pennsylvania Railroad Company, Philadelphia, Pa.

M. L. Lissberger, Mark Lissberger & Son, Inc., New York.

D. M. Buck, American Sheet & Tin Plate Co., Pittsburgh, Pa.

W. M. Corse, Ohio Brass Company, Mansfield, Ohio.

Messrs. Burgess and Woodward, United States Bureau of Standards, read by Dr. P. D. Merica, also of the Bureau. "CADMIUM AND ITS SOURCES," by C. B. Siebenthal of the United States Geological Survey, read by Dr. Merica.

J. L. Jones of the Westinghouse Electric & Manufacturing Company took part in the discussion, but stated that he had covered the ground in his paper on babbitts, which was presented at the Tuesday meeting. The papers presented by Messrs. Thompson, Clamer, Waring, Buck and Corse, in whole or in part, are published in this issue of THE METAL INDUSTRY and are very timely at this time when the conservation of tin is affecting every consumer of the metal.

WEDNESDAY AFTERNOON, OCTOBER 8.

The meeting was opened with a continuation of the discussion on the conservation of tin. This was followed by the reading of the paper on the "VOLATILITY OF THE CONSTITUENTS OF BRASS,"[6] by John Johnson.

W. H. BASSETT,
Vice-President

During the discussion of this paper Dr. J. W. Richards, professor of metallurgy at Lehigh University, suggested that large industrial concerns interested in the subject subsidize a university and have research work done.

Other papers read at this session were: "NOTES ON THE METALLOGRAPHY OF ALUMINUM," by P. D. Merica and J. R. Freeman, Jr.,; THE EFFECT OF IMPURITIES ON THE HARDNESS OF CAST ZINC OR SPELTER,"[7] by G. C. Stone. "DENTAL ALLOYS," by A. W. Gray, with an extensive series of photo-micrographs, closed the educational part of the session for the day.

ELECTION OF OFFICERS.

The annual election of officers of the division for the year 1918-1919 then took place with the following result. Those names marked * indicate re-election:

Chairman, W. M. Corse;* secretary, F. L. Wolf;* vice-presidents, W. B. Price,* Scovill Manufacturing Company, Waterbury, Conn.; G. K. Burgess,* Bureau of Standards, Washington, D. C.; H. J. Roast,* James Robertson Company, Ltd., Toronto, Canada; C. H. Bierbaum, Lumen Bearing Company, Buffalo, N. Y.; Sir Robert Hadfield, London, England; W. F. Frank, Damascus Bronze Company, Pittsburgh, Pa.; O. H. Mathewson, Yale College, New Haven, Conn.; Zay Jeffries, Aluminum Castings Company, Cleveland, Ohio, and W. H. Bassett,* American Brass Company, Waterbury, Conn.

THURSDAY, OCTOBER 10.

The first paper taken up at this session was read by G. C. Stone, who presided, and was on "ELECTROLYTIC

[1] Bulletin A. I. M. E. No. 138, p. 1037.
[2] Bulletin A. I. M. E. No. 142.
[3] Bulletin A. I. M. E. No. 140, p. 1397. THE METAL INDUSTRY, September, 1918.
[4] Bulletin A. I. M. E. No. 135, p. 645
[5] Bulletin A. I. M. E. No. 140, p. 1156.
[6] Journal of American Institute of Metals, March, 1918, p. 15.
[7] Journal of American Institute of Metals, March, 1918, p. 11.

ZINC,"[8] by C. W. Hansen, with a written discussion[9] by J. L. McK. Yardley. This was followed by a paper on "THE CONDENSATION OF ZINC FROM ITS VAPOR,"[10] by C. H. Fulton.

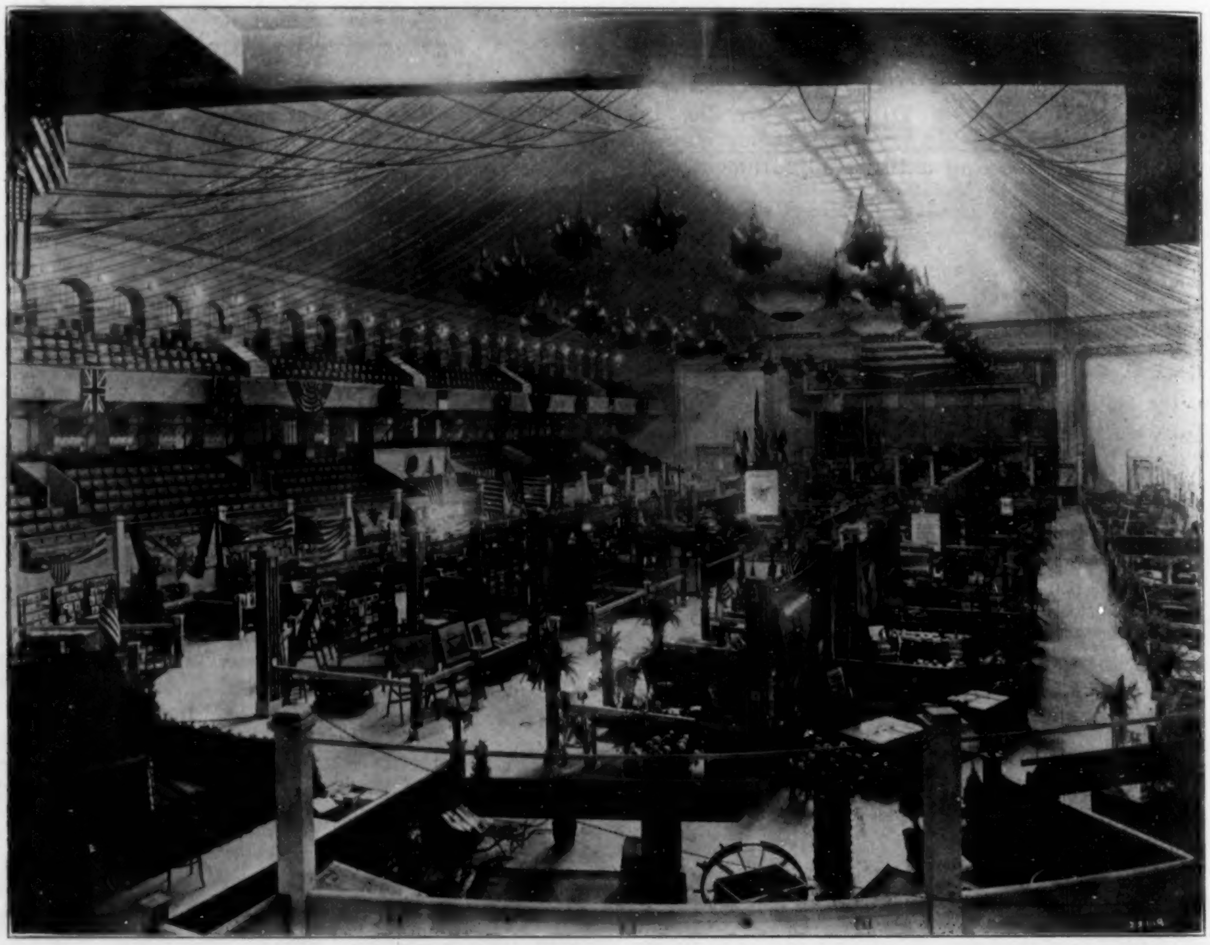
The paper which followed the zinc papers was one on "THE ACTION OF REDUCING GASES ON COPPER,"[11] by Norman B. Pilling. W. H. Bassett, in discussing this paper, stated that the problem had been worked out by Heyn in 1904, that the action of reducing gases such as hydrogen and nitrogen in copper was well known to metallurgists. He then showed a number of micrograph slides that illustrated plainly the deterioration caused in copper by these gases.

An interesting paper with a large number of micrograph views was read and discussed by G. F. Comstock on "NOTES ON NON-METALLIC INCLUSIONS IN BRASSES AND BRONZES."[12] Other papers at this session were "NICHROME CASTINGS," by Arlington Bensel of the Driver-Harris Wire Company, Harrison, N. J.; "FUSIBLE PLUG MANUFACTURE," by Messrs G. K. Burgess and L. J. Gurevich; "THE APPLICATION OF THE SPECTROSCOPE TO THE CHEMICAL DETERMINATION OF LEAD IN COPPER," by Messrs. Hill and Luckey, and the "METAL RADIUM,"[13] by Richard B. Moore.

[8]Bulletin A. I. M. E. No. 135, p. 615.
[9]Bulletin A. I. M. E. No. 142.
[10]Bulletin A. I. M. E. No. 140, p. 1375.
[11]Bulletin A. I. M. E. No. 142.
[12]Jour. American Institute of Metals, March, 1918, p. 5.
[13]Bulletin A. I. M. E. No. 140, p. 1165.

THE BANQUET.

One of the most important and successful functions of the convention was the banquet held at the Auditorium Thursday night. The delegates, their wives and friends gathered to the number of 550 and discussed a simple menu, during which they were entertained by a stringed orchestra and a male quartet, who rendered patriotic songs. The toastmaster was Theodore O. Vilter. The guest of the evening was Charles M. Schwab, who delivered an inspiring and patriotic address. His simple democratic manner and fascinating smile captivated his audience, who were with him from the start. Mr. Schwab made the very popular declaration that the war would be finished in our own way and that would mean the best way for the future of the world.



VIEW OF MAIN HALL IN MILWAUKEE AUDITORIUM AT EXHIBITION OF FOUNDRY SUPPLIES AND EQUIPMENT, HELD BY AMERICAN FOUNDRYMEN'S ASSOCIATION IN MILWAUKEE, WIS., OCT. 7-11, 1918.

Major A. Radclyffe Dugmore, who fought in France and Belgium at the beginning of the war and who was wounded at the battle of the Somme, held the attention of everyone for a full hour by his graphic and stirring recital, illustrated with Pathé moving pictures, of the part Great Britain has taken in the war.

W. H. Blood, Jr., assistant to the president of the American Shipbuilding Corporation, delivered a finished address giving a description of the inception and constructon of the Hog Island shipyards at Philadelphia, Pa. His talk was very effectively illustrated by means of moving pictures.

THE CONSERVATION OF TIN

A Symposium Held at the Convention of the Institute of Metals Division of the American Institute of Mining Engineers at Milwaukee, Wisconsin, October 9 and 10, 1918.

DR. G. W. THOMPSON, NATIONAL LEAD COMPANY, NEW YORK

This subject has two aspects, neither of which can be ignored. These two aspects are the economic aspect and the technical aspect. Under ordinary conditions economic law will take care of the conservation of tin. Under present conditions it seems to be desirable that economic law should still be permitted to operate as far as is practicable. It is true that economic law operates rather slowly and that under war conditions it cannot be depended upon to give our Government the supply it immediately needs. There should therefore be a designation of the essential industries, made by the Government, and tin supplied for those needs, letting the non-essential industries take what is left. There should be an endeavor at the same time to promulgate information as to how tin can be conserved. With tin selling at one dollar per pound, more or less, there should be an ample inducement to consumers, in the direction of conservation. It is to the interest of every consumer to get the best information he can as to how he can save tin and save money thereby in his business. Economic law would properly punish those who do not study their own interests in this way. I deprecate therefore any centralized socialistic effort looking solely to the prevention of penalties being incurred from a failure to observe and obey economic law. In saying this, however, I am not unmindful of the desirability of our Government taking such control of the tin situation as may be necessary to the prosecution of the war, practically regardless of the effect of such action upon individual industry which should seek studiously to adjust itself to the new condition. The Government should promulgate such technical information as it can collect, showing how tin can be conserved, and should urge upon every consumer the exercise of his God given attribute of common sense in self protection. There is very little danger of any one attempting to hoard or corner tin, in the present state of the market. Most consumers will be glad to live from hand to mouth, covering their sales by purchases, or vice versa.

A VIEW OF MACHINERY HALL IN THE BASEMENT OF MILWAUKEE AUDITORIUM AT THE FOUNDRYMEN'S EXHIBIT, MILWAUKEE, WIS., OCT. 7-11, 1918.

Now as to the technical aspects: The Government has collected valuable information, which it has wisely disseminated, showing how tin can be conserved. This information relates to the use of tin in babbitts, solders, tin-plate, electrical industries, etc. It should be unnecessary to do more than make this reference, as you are probably well informed of all of the recommendations to the Government.

There is this, however, to be said: Tin and tin alloys are used to give certain practical results and also to give certain artistic results which appeal only to the eye. The

practical results are those involved in proper adhesion, continuity of surface, protection, the right degree of hardness, proper working qualities, etc. The artistic results are those that appeal purely to the eye or to our cultivated sense of what is desirable. There is no doubt that a great deal of tin could be saved if there were not a demand for certain pleasing effects. How can this saving be brought about? The users of tin bearing alloys are not the only ones involved in this question. The manufacturers of solder and babbitt have for a long time sought to give certain appearances to their solder and babbitt bars in order to make them more salable. The user of a solder is very apt to judge of its working qualities by the appearance of the bar. The same thing is true with regard to babbitts. Under ordinary conditions manufacturers are perfectly justified in trying to produce attractive and consequently more salable products. It would seem, however, that if solder and babbitt were cast in closed molds, just as good practical results would be obtained by the user, without his being able to give preference to solders of unnecessarily higher grade on account of their appearance. It would be hopeless for any one manufacturer of solder to undertake a change of this kind, but if all manufacturers of solder agreed upon it, they would be able, in my opinion, to get the users of solder to take and to approve by their practical tests metals containing less tin than they have been accustomed to. The same is true with regard to babbitt metals.

An illustration of how, in the use of an alloy, appearance sometimes is deceptive, is to be found in the case of what you may call intermediate babbitts. I am thoroughly convinced that high tin or high lead babbitts are better than those babbitts containing both lead and tin with relatively high percentages of each. A high tin babbitt should not contain more than ten per cent of lead and a high lead babbitt should not contain more than ten per cent of tin, roughly speaking. The intermediate babbits, such as those that contain from thirty to seventy per cent of lead or tin, give nice appearing castings that flow easily, but they have not the serviceability of the high lead or high tin babbitts. Their hardness goes down very rapidly as the temperature rises and they have a relatively low softening point due to the eutectic components present.

G. H. CLAMER, FIRST VICE-PRESIDENT AND SECRETARY, AJAX METAL COMPANY.

BRONZE BEARING METALS.

Unfortunately, prior to the War no serious attention was given to the conservation of tin, notwithstanding that this country is practically entirely dependent upon outside sources for its tin supply.

Tin is of vital importance in many industries, but it is surprising how many and how excellent are its substitutes when we become acquainted with them. Tin has always been a relatively high-priced metal, and it is part of the human attitude to associate high prices with high standards; it is not until the price of a commodity becomes well-nigh prohibitive that we hunt for substitutes, because the idea of substitution seems always to involve an assumption that the substitute must necessarily be inferior.

The history of the development of bearing bronzes is a striking example of this policy. In the early days, copper-tin alloys were almost universally used for bearings, the idea then being prevalent, and is still held by many, that a bearing to resist wear must be hard, and the harder the better. The favorite bronze bearing contained 90 per cent copper and ten per cent tin; frequently, in service which was considered severe, even higher proportions of tin were used. Such hard alloys have great resistance to compression, but as a rule they had a very wide factor of safety in this respect. Such bearings, because of their inability to adjust their surfaces to slight irregularities in the journal, or to foreign bodies, immediately begin to cut, and heating results. With a slight rise in temperature, the film of lubricant becomes thinner, and further cutting follows, if not actual gripment of the bearing with the journal.

BEARING ALLOYS CONTAINING LEAD.

Many years ago, Dick, of England, appreciating the advantage to be derived from a slight plasticity in a bearing, added some lead to the then standard bearing metal, not substituting lead for tin but reducing the copper, and produced the alloy, which has long held favor as a bearing metal, copper 80, tin 10, lead 10 per cent. Dick's alloy also contained some phosphorus, but the main point is that this was the first step towards the production of bronze alloys having a plastic nature. Lead does not unite to form an alloy with copper, but remains mechanically mixed, so that the structure of the alloy is that of a hard matrix with the soft metal imbedded therein.

It was not until several years later that tests were conducted on the Pennsylvania Railroad, under the direction of Dr. C. B. Dudley, who investigated the copper-tin-lead series within certain limits of the 80-10-10 alloy; he studied not only the alloys containing lead above 10 per cent in which copper was replaced by lead, but also in which tin was replaced by lead. His conclusions, which have since become firmly established, are: (1) The rate of wear diminishes with increase of lead in the alloy. (2) The rate of wear diminishes with decrease of tin in the alloy. Fortunately, the alloy containing least tin and highest lead exhibits least tendency, in service, to give trouble from heating.

Notwithstanding the decided merit of copper-tin bearings containing lead, prejudice was strongly against them, simply because lead is a low-priced metal. It was even intimated that such alloys were frauds, should be considered such, and dealt with accordingly.

I have mentioned Dr. Dudley's discoveries because it was due to his findings that we instigated research work, now 20 years ago, which has led to the production of alloys still higher in lead and lower in tin than those which he was able to produce. He experienced foundry difficulties which apparently limited his maximum lead alloy to 77 copper, 8 tin, and 15 lead. This was called Experiment B alloy, and has since been widely known as "Ex. B metal."

Having found due regard to the raw materials used, and by following good foundry practice, we have been able to produce alloys carrying 5 per cent of tin and as much as 30 per cent of lead which would show no segregation of lead, even if cast into large bearings. By this I mean that such bearings will show no indication of metallic lead upon any surfaces. Lead being only mechanically held in the alloy, it is prevented from segregating only by the quick setting of the matrix of copper and tin. As a certain interval must necessarily occur between the time when the metal enters the mold and the time when it solidifies, the lead always shows some tendency, owing to its high specific gravity, to liquidate toward the bottom of the casting. In bearings made of the proper raw materials, and correctly handled, the difference in the proportion of lead is not usually over a fraction of one per cent, or at most 2 or 3 per cent, the top and the bottom of a casting, even if this be a fairly large one, and made of the 30 per cent lead alloy.

I do not wish to repeat here data which I have given

in previous papers* but I do wish to set forth the position which the high-lead and low-tin alloys developed by us have attained. When these alloys were first produced they were backed only by laboratory tests and by the predictions of Dr. Dudley that, if such alloys could be commercially produced, the law which he established would no doubt apply also to alloys higher in lead and lower in tin than those which he had developed. It is now possible for me to review 18 years' experience with the manufacture and service of such bearings. I must confess that in our enthusiasm over the valuable properties of these alloys, we were led at times to overstep the mark and place such bearings in service where the loads or the impacts were too great.

The first requisite of a bearing is that it shall be sufficiently hard to support its load or to resist the impacts to which it may be subjected, and the relation of tin to lead must be controlled by this requirement. We have sometimes made mistakes in recommending the copper 65, tin 5, lead 30, alloy for certain mill bearings, but this did not have sufficient resistance to compression, and failed for that reason. When the copper 73, tin 7, lead 20 alloy was substituted the bearings exhibited no deformation and performed far better than the 80-10-10 alloy previously used. We have also noted the failure of the 73-7-20 alloy on rod bearings of very heavy locomotives. Locomotive rod bearings are subjected to severe impacts and it is necessary therefore to use an alloy of fairly high compressive strength. Although the above alloy performs satisfactorily on light locomotives, on the rod bearings of heavy locomotives it is necessary to use either the 80-10-10 alloy or the same alloy to which has been added approximately 1 per cent of phosphorus. The size of these bearings, and hence their bearing surface, is narrowly limited by necessities of construction; otherwise these harder alloys would not be essential for this purpose. Phosphorus greatly increases the compressive strength of such an alloy, and is for this reason a possible factor for conserving tin. At the present prices of tin and phosphorus there is little choice; an alloy with 8 per cent of tin and 1 per cent of phosphorus will have compressive strength approximately equivalent to the alloy having 10 per cent tin. Experience, thus, has demonstrated that alloys containing as little as 5 or even 4 per cent tin and as high as 30 per cent lead, can be used in railroad service for the densest traffic. They have become the standard of the United States Railroad Administration for car-journal bearings called for under their Specifications R-71 Grade A. Such an alloy is also included in the specifications covering locomotive bearings designated as Specification R-72, Soft Bronze.

In my judgment, the specifications of the Railroad Administration covering locomotive bearing-metals are very satisfactory, except that the use of soft bronze should be extended to cover driving brasses, and engine and trailer-truck bearings. Before the Railroads of the United States came under Government control, copper alloys with low-tin and high-lead contents had become the standard specifications of several of the large car companies, and were very extensively used on the largest railroad systems. Outside of the railroad field they had also been widely recognized and used. The advantage of using the smallest possible amount of tin consistent with the load requirements is now so well understood, that there is but little opportunity for an important conservation of tin in this field.

*For example: A Study of Alloys Suitable for Bearing Purposes. Jnl. Franklin Inst. (July, 1906), 156.495 Amer. Soc., History and Development of the Alloy Practice in the United States as Applied to Railway Bearings, Proc., Testing Materials (1907) 7,302; Amer. Inst. Metals (1915) 9,241, Effect of Changes in the Composition of Alloys Used by the American Railways for Car-journal Bearings, Trans.

SUBSTITUTES FOR TIN.

Let us next consider the possibilities of substituting some other metal for a part or all of the tin in a copper-tin-lead alloy, or of substituting alloys of an entirely different type.

The first metal that presents itself as a substitute for tin is antimony. Antimony combines readily with copper and with lead, and has the property of adding hardness. Unfortunately, however, the hardening effect of antimony is obtained with the sacrifice of ductility. We have found it possible to make alloys carrying as high as 30 per cent of lead with 3 per cent of tin and 2 per cent of antimony. We have also made alloys of 65 copper, 30 lead, 2 tin, and 3 antimony, and have also replaced the 5 per cent of tin in this alloy entirely with antimony. Car bearings 4¼ x 8 in. size made from the same pattern and subjected to a breaking stress applied longitudinally at the middle of the back of the bearing and throughout its entire length, broke at the following average loads: With 2 per cent antimony substitution, 60,000 lb.; with 3 per cent substitution, 61,000 lb.; with total substitution, 52,000 lb.; as compared with a breaking load of 67,000 lb. for the alloy of copper 65, tin 5, lead 30. The castings produced with each of the three above-mentioned alloys are not so satisfactory as those made with the straight tin alloys, being more or less rough, and showing slight globules of lead on the surface. It has been found that a certain amount of nickel can be used for replacing tin with very satisfactory results. The castings produced when zinc is substituted for a certain amount of tin are decidedly unsatisfactory. The substitution of aluminum for tin is entirely impracticable, and such castings are worthless. This does not, however, exhaust all the possibilities of substituting other metals for tin in the copper-tin-lead alloys, but it is my opinion that the substitution of any other metals, in those alloys, can be made only by sacrificing the quality of the alloy.

The possibility of substituting alloys of an entirely different type presents an attractive field for research. The copper-tin-lead alloy has attained its position as the most desirable bronze bearing alloy, but this does not mean that some other alloy may not be found which may give equally good or better results. In the search for such substitute alloy it should be borne in mind that a bearing metal should possess the following properties:

PROPERTIES FOR A BEARING METAL.

(1) It should be sufficiently rigid to support the load or resist the impact, but yet not so brittle that it will easily crack.

(2) It should have as great a yielding or plastic nature as is consistent with its ability to support the load or resist the impact without deformation of the bearing as a whole.

(3) The ideal structure combines a hard matrix to support the load and a softer metal or alloy contained within such matrix, to permit the bearing surface to adjust itself to irregularities of surface.

(4) It should be easy to handle in the foundry and machine shop.

(5) It should be capable of being remelted without deterioration.

(6) For use in babbitt-lined bearings, it should be capable of being tinned, so that the babbitt can be applied thereto.

(7) It should have good heat conductivity in order to dissipate the heat generated by friction.

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THE TIN-PLATE INDUSTRY.

During the first 5 months of 1918, approximately 11,000,000 lb. per month of pig tin were consumed in the United States. Solder bearing metals, bronzes, etc., used about 5,500,000 lb.; collapsible tubes a little more than 250,000 lb.; tin-foil about 500,000 lb.; and the tin- and terne-plate industry somewhat less than 5,000,000 lb. In an effort to reduce this consumption and thus conserve our tin supplies, several methods of procedure suggest themselves:

1.—Salvage. The most careful and systematic collection and re-use of tin and tin-bearing materials is economically important, in that we thus secure the maximum benefits from our available supplies.

2.—Substitution of other materials for tin. While tin, on account of its low melting point, softness, malleability, nontoxicity, etc., is peculiarly adapted for many uses, nevertheless it may seem desirable, during times of temporary stringency at least, to substitute for tin and for tin-bearing materials some other substances which may answer our purposes, though perhaps not possessing all of the desirable qualities of tin. It is conceivable that research in this connection may develop entirely satisfactory substitutes which may permanently replace tin for certain purposes.

3.—Curtailment, for the time being, of certain lines of manufacture, not absolutely essential to the prosecution of the war.

Efforts along all of the above-mentioned lines are being made in practically all tin-consuming industries, and much progress has been made. In considering the details of tin conservation, it is my intention to confine myself to a brief discussion of this subject as related to the tin- and terne-plate industry.

Terne-plate is a mild-steel sheet coated with an alloy of tin and lead (approximately 25 per cent tin and 75 per cent lead). Its chief uses, in normal times, are for roofing, gasoline and oil tanks, and for stamping into various forms. Manufacturers of this material have almost entirely discontinued its manufacture, except to supply the urgent needs of the Government for war purposes.

It has been customary to use a small amount of tin with the spelter in the galvanizing pots in the manufacture of galvanized sheets. It has been found that, by a sacrifice of no other quality than appearance, this tin could be omitted, and the practice has been largely discontinued —entirely so in the concern with which the writer is connected.

Tin-plate consists of thinly rolled mild-steel sheets coated with pure tin, and its chief use is in the canned-food industry. The Government has requested that the manufacturers of this product give absolute priority to orders covering material to be used for the manufacture of plate for cans to contain perishable foods. The manufacturer has, of course, complied with this request and the conditions of the markets have been such that almost the entire capacity of the country has been utilized for such material, and for other direct and indirect Government needs.

Several grades of tin-plate are regularly manufactured, differing only in thickness of the tin coating. While, for some few uses, the heavier coated sheets are desirable and necessary, it is a fact that the most lightly coated sheets are entirely suitable for a very large percentage of these requirements. It is in this connection that the consumer can materially aid in the saving of tin during the present stringency, and also prevent a serious economic waste in normal times, by not specifying a heavier coated plate than his requirements justify.

For years it was believed by certain canners, manufacturers, and dealers in canned goods, that a heavy tin coating was necessary on food containers. This opinion was endorsed by food officials and chemists, and attempts have been made in Congress to regulate the weight of tin coating. Since the literature on the subject gave no definite information, a committee was formed several years ago, consisting of representatives of the American Sheet and Tin Plate, American Can, and the National Canners Association. Two representatives of the Bureau of Chemistry, Department of Agriculture, also participated in the work. This committee prepared seven lots of tin-plate with the following average coatings, expressed in pounds of tin per base box (112 sheets, 14 by 20 in.):

A........0.9 lb.	E........1.8 lb.
B........1.1 lb.	F........2.1 lb.
C........1.3 lb.	G........3.0 lb.
D........1.5 lb.	

Cans were made from these plates in the usual way, and various food products were packed under the supervision of the committee, in regular canning plants. Approximately 60,000 cans, in all, were packed with the following foods:

Apples (3 packs)
String Beans
Cider
Clam Juice
Corn (3 packs)
Milk (condensed)
Milk (evaporated)
Peas
Pumpkin (3 packs)
Tomatoes (3 packs)
Tuna
Salmon

The cans and contents were inspected and analyzed from time to time, throughout a period of about 18 months after filling the cans. In this work more than 40,000 samples were analyzed chemically. I quote from the general conclusions of this committee as embodied in their report:

"The most significant fact established by this entire investigation is that, aside from the external appearance of the cans, none of the difficulties encountered in the twenty experimental packs of twelve representative foods in plain cans was taken care of or eliminated by heavy tin coatings. . . . The luster and the resistance to rusting increase somewhat with increased weights of coating. In other respects, with the exception of some instances in those classes of foods that have a tendency to perforate, the conclusion from this work is that the value of different weights of tin coating on food containers is for all practical purposes the same with average weights of from one to three pounds of tin per base box."

I bring this investigation to your attention to emphasize the needless waste attendant upon the use of tin plate with an unnecessarily heavy tin coating. With our present knowledge, we are unable commercially to produce coatings as light as the lower weights used in this test. If, however, future research should develop means to this end, the resultant product would meet all practical requirements, and a very considerable saving in pig tin would result.

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THE ALUMINUM BRONZE INDUSTRY.

The conservation of tin, in view of the shipping situation, is one of great importance. Several methods of conservation can be employed:

1.—Reduction of the amount of tin in an alloy or compound.

2.—Substitution of an entirely different metal or compound for tin.

3.—A combination of the first and second methods.

The second method is the one that I wish to discuss.

Metallic aluminum has been known for a long time, and its use in copper alloys was discovered about 1855 by Lord Percy. The high cost of production of metallic aluminum retarded its commercial development, and it was not until the discovery of the electro-chemical processes for its production that it came to be known as a common metal.

I have been particularly interested, for the past few years, in working with the alloy known as aluminum bronze, which is usually composed of approximately 90 parts of copper and 10 parts of aluminum, by weight. This alloy has many properties similar to the copper-tin bronzes, and it has been of interest to find just where the copper-aluminum bronzes could be substituted for the copper-tin bronzes, and in that way conserve the use of metallic tin.

Copper-aluminum bronzes have practically double the tensile strength of tin bronzes, so that a smaller cross-section frequently can be adapted, with the same mechanical result. Their resistance to shock is superior to that of the copper-tin bronzes, and their resistance to wear is, in some cases superior, and in some cases practically equal. Consequently, for many mechanical uses, where a hard bronze is desired to replace one containing 10 to 11 per cent of tin, for example, an aluminum bronze of about the composition mentioned will be found worth investigation. Undoubtedly no two alloys possess exactly the same properties and when a substitution of one for the other is desirable, it is necessary to work our special methods of handling the substitute in order to get practically the same results.

As is frequently the case in such work, special properties are found to be superior to those of the metal originally used, and other properties are discovered to be not so good. As a particular instance of the substitution of aluminum bronze for phosphor bronze, I would cite its use in worm gearing. The following tables taken from my paper* on this subject before the Society of Automotive Engineers will give an idea of the different properties.

Table 1.—Physical Properties of Phosphor Bronze.
Composed of 88.7 parts of copper, 11 parts of tin, and 0.3 parts of phosphorus.

Ultimate tensile strength, lb. per sq. in.	35,000-40,000
Yield point, lb. per sq. in.	22,000-25,000
Elongation in 2 in., per cent	6-10
Reduction of area, per cent	7-9
Specific gravity at 20°	8.5
Brinell hardness number (500 kg. load for 30 sec)	75-85
Pattern maker's allowance for shrinkage, in. per ft	0.125
Weight per cu. in. lb	0.31
Compression, elastic limit, lb. per sq. in.	16,000
Coefficient of friction	0.0040
Modulus of elasticity	12,000,000 to 14,000,000
Resistance to impact, Fremont notched-bar test (fractured section 7 by 10 mm.), kg.-meters	2 to 4
Endurance of alternation impact, Landgraf-Turner of Arnold test, alternations	150 to 400
Resistance to shear by impact, McAdam machine, ft.-lb	300 to 450

Aluminum bronze containing 10 per cent aluminum and 1 per cent of iron has the physical properties shown in Table 2.

Table 2.—Physical Properties of Aluminum Bronze.
(Containing 10 per cent of Aluminum and 1 per cent of Iron.)

Ultimate tensile strength, lb. per sq. in.	65,000-80,000
Yield point, lb. per sq. in.	23,000-28,000
Elongation in 2 in., per cent	20-30
Reduction of area, per cent	21-29
Specific gravity at 20°	7.5
Brinell hardness number (500 kg. load for 30 sec.)	92-100
Pattern maker's allowance for shrinkage, in. per ft.	0.22
Weight per cu. in.	0.27
Compression, elastic limit, lb. per sq. in.	19,000
Coefficient of friction	0.0025
Modulus of elasticity	15,000,000-18,000,000
Resistance to impact, Fremont notched-bar test (fractured section 7 by 10 mm.), kg. meters	7 to 10
Endurance of alternating impact, Landgraf-Turner or Arnold test, alternations	3500 to 5500
Resistance to shear by impact, McAdam machine, ft.-lb.	750 to 850

It is of interest to note that aluminum bronze would undoubtedly have been substituted for phosphor bronze before this had the manufacturing difficulttíes with the former been surmounted. Aluminum bronze, when cast in the foundry, presents about as difficult a problem as I have ever seen. It is very sensitive to gas absorption and must be handled extremely carefully to insure good castings. It is similar, from a foundryman's standpoint, to manganese bronze, in that it requires large risers and careful pouring to insure clean castings. Several years' work on this alloy has demonstrated conclusively that it is perfectly possible to make as large a percentage of good castings from it as from any other non-ferrous alloy. It seems to me therefore that its use should be increased, particularly in view of the shortage of tin at the present time, and undoubtedly new fields will be opened up as its various properties are better known.

One feature that stands out prominently, which was mentioned by the eminent English investigators of this type of alloys and published by them in the 8th and 9th reports of the Alloys Research Committee of the Institution of Mechanical Engineers of Great Britain, is the fact that cast aluminum bronze possesses properties equal to those of rolled aluminum bronze. Nearly all copper-base alloys are improved by rolling processes, but the copper-aluminum alloys seem to possess equally good properties when cast or rolled; this is a remarkable metallurgical fact. Another important property of these copper-aluminum alloys is their resistance to alternating stress. Many tests indicate that their resistance is greater in this respect than that of some steels, and I have seen instances when cast aluminum-bronze bolts have outlived five steel bolts in foundation work subject to severe shocks. I mention these various instances to indicate that work originally started as research for substitution of one material for another frequently develops an article which has properties not possessed by the original metal or alloy.

I have dwelt particularly on the aluminum bronzes because recently I have done more special work on them than on other alloys, but I believe that the use of aluminum itself, in many combinations of metals, is a very important subject for investigation. Undoubtedly, after the war, the cost of aluminum will be reduced from its

*Worm Gear Bronzes, W. M. Corse, Journal, Society of Automotive Engineers, April, 1918.

present price, and considering its low specific gravity it offers a very interesting and important field for research in the metal business. Naturally, if combinations containing aluminum can be developed in view of a probable increasing supply of metal, the cost will be reduced. This will benefit the industry generally and will immediately conserve tin.

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PENNSYLVANIA RAILROAD ANTI-FRICTION AND BELL METALS.

The necessity for conserving tin has recently been very forcibly brought to the attention of all consumers, and efforts are now being made to reduce the tin content in certain alloys or to substitute other alloys not containing tin.

The approximate composition of the non-ferrous alloys in general use on the Pennsylvania Railroad are as follows:

	Copper	Tin	Lead	Phos	Anti	Zinc
Phosphor bronze, Spec. 32-C,	79.70	10.00	9.50	0.80	....	...
Ex. B. bronze, Spec. 141,	76.75	8.00	15.00	0.25	....	...
Car-journal bronze (a)	(b)	(c)	(d)	(e)	....	(f)
Special high-lead bronze, Spec. 59	70.00	5.00	25.00	...	....	...
Lining metal, Spec. 57	....	...	87.00	...	13.00	...
Dandelion metal	....	10.00	72.00	...	13.00	...
Bell metal	83⅓	16⅔	....	...	....	...
Babbitt, tin-base	3.70	88.90	....	...	7.40	...
Babbitt for motor bearings	1.00	50.00	38.50	...	10.50	...

(a) Sum of Cu, Pb, Sn, and Zn, not less than 99.
(b) Sum of Cu, Pb, Sn, and Zn, not less than 71.
(c) Sum of Cu, Pb, Sn, and Zn, not less than 4.
(d) Sum of Cu, Pb, Sn, and Zn, not less than 13.
(e) Sum of Cu, Pb, Sn, and Zn, not more than 20.
(f) Sum of Cu, Pb, Sn, and Zn, not more than 3.

Phosphor bronze is used principally for rod bushings, main-rod brasses, and crosshead shoes.

Ex. B bronze is used to a small extent for backs of car and coach bearings, but the majority of these are now made of the car-journal bronze, which contains, on the average, about 5 per cent tin.

Car-journal bronze is used for making car and coach bearing backs at the Altoona brass foundry, by melting down old backs after removing the linings and making the necessary addition of new metal to bring the composition within the limits given above. No new tin is added in making this alloy.

Special high-lead bronze is used principally for locomotive driving-box shells, which are not lined.

The lead-base lining for car-journal bearings was formerly made up in our foundry from lining metal melted off from old bearings and brought up to specification requirements by the addition of such new metal as might be necessary. Some tin was unavoidably introduced from the old bearings, but the amount allowed in the metal was limited to 2 per cent. Lately we have been using this old lining metal in the preparation of the lead-base dandelion metal babbitts, thus making use of the contained tin in order to reduce the amount of new tin which it was necessary to add to this metal. The journal-lining metal is then made from lead and antimony without the addition of any tin.

Lead-base dandelion metal babbitt, containing about 10 per cent tin, is used for lining cross-head shoes and also for lining engine truck and trailer bearings, as well as for hub liners, in place of phosphor bronze, on freight locomotives. This metal has replaced a large amount of tin and tin-base babbitt formerly used.

Bell metal is used exclusively for making locomotive bells, and during 1917 about 42,800 pounds of castings were made, involving the use of a little over 7,000 pounds of tin.

Tin-base babbitt metal (88.9 tin, 3.7 copper, 7.4 antimony) is used for a number of miscellaneous purposes in the shops, but its use has been greatly restricted and every effort is being made to do away with it where possible, and to substitute a lead-base babbitt or a babbitt with 50 per cent tin.

The amount of solder having the composition 50 lead, 50 tin, used by the Pennsylvania Lines East, during 1917, was approximately 100,000 pounds, but there is reason to believe that a large portion of this can be replaced by a 60-lead, 40-tin solder with satisfactory results, and instructions have been issued to this effect.

In regard to the quantity of new tin used, it is not possible to give the amount except approximately, and from calculations based on the 1917 consumption of bearing metals by the Pennsylvania Lines East only, it is estimated that about 770,000 pounds of new tin were required in a total of about 21,380,000 pounds of all kinds of bearing metals turned out by the foundry or purchased in the market.

No change has been made in the specifications for bearing metals for some years, as the metals used have been satisfactory. A large proportion of the bearing metals are made up from old material remelted and brought to standard composition by some addition of new metal, and every effort is being made to utilize old material to the best advantage and reduce the amount of new metal of all kinds purchased. For a number of years no tin has been used in the lining metal of either passenger or freight car journal bearings except such small amounts as come in from remelting old linings. No change has been made in phosphor bronze used for rod bushings, as we should expect some trouble from bushings pounding out of shape if a phosphor bronze were used which contained less tin or more lead than the present specifications call for. In this, as well as in the case of all other bearing metals, we expect to use our utmost endeavors to economize and to substitute for tin wherever possible.

PRODUCTION OF METALLIC MAGNESIUM.

Metallic magnesium, which is commonly used as a flash light in photography, is used also in aerial bombs and rockets for lighting battle fields at night. Burning magnesium makes a dense pure white cloud, and it is put into shrapnel shells so that observers and gunners may know exactly where the shells are bursting. It is a veritable cloud by day and pillar of fire by night on the European battle fields.

Magnesium is made by the Norton Laboratories, Inc., at Lockport, N. Y., the American Magnesium Corporation, Niagara Falls, N. Y., and the Rumford Metal Company, Rumford, Maine. Reports made by these three companies to the United States Geological Survey, Department of the Interior, show a production of 50,384 pounds of metallic magnesium in the first quarter of 1918, and 66,554 pounds in the second quarter, making a total of 116,938 pounds in the first half of 1918. The total production in 1917 was 115,800 pounds.

PURE CARBON FREE MANGANESE AND MANGANESE COPPER

A Paper Presented Before the Metal Division of the American Institute of Mining Engineers at Milwaukee, Wis., October 10th, 1918.

By Arthur F. Braid.*

On account of the war, there has been an increasing scarcity of phosphorus and its well-known alloys of copper and tin. During the same period, the production of brass or bronze, nickel silver, cupro-nickel and other non-ferrous alloys, has considerably increased. The manufacturers of these products had therefore to secure other materials which would answer their purpose, which is principally that of a deoxidizer and which could be obtained promptly and regularly.

ARTHUR F. BRAID.

Fortunately these materials, pure carbon free manganese metal and manganese copper alloy were not hard to find—in fact they were never lost. Manganese, in various forms, has been used in European countries for more than a century. In this country, however, when manganese was first used, and indeed for a long time after, it was used principally in the manufacture of manganese-bronze. There was also the somewhat natural tendency on the part of many foundrymen at that time to use manganese-copper with the same freedom as phosphor-copper. Although iron enters into the composition of certain grades of bronze, it is very detrimental to the general run of non-ferrous mixtures; consequently ferro-manganese is not applicable and therefore pure manganese metal or its alloy of manganese and copper which are technically free from iron and other impurities, are now being generally used.

The following list shows the principal elements having an affinity for oxygen.

1. Sodium; 2. Potassium; 3. Calcium; 4. Strontium; 5. Barium; 6. Magnesium; 7. Aluminum; 8. Phosphorus; 9. Silicon; 10. Manganese; 11. Iron; 12. Zinc; 13. Lead.

Each metal has its natural flux, or deoxidizer in the shape of a metal or non-metal which will alloy with it, and which has a strong affinity for oxygen. For example, phosphorus as is well known acts very beneficially in copper alloys which contain tin.

Within the last few years, however, and particularly since the war started, the great value of Manganese in nickel alloys has been demonstrated, and one by one the manufacturers of these products have adopted its use.

While Manganese has not such a strong affinity for oxygen as magnesium, aluminum or silicon, it is nevertheless sufficiently powerful to reduce any oxide of nickel, copper or zinc which may be present in the nickel alloy to be purified.

It is this "medium" affinity for oxygen, so to speak, that renders manganese valuable in casting nickel alloys for rolling or drawing purposes as the oil which burns at the mouth of the mold is capable of reducing the thin film of oxide or manganese which forms upon the stream of metal as it is poured. Aluminum or silicon oxides are not reduced by burning oil, and, therefore, it too frequently happens that dirty castings are produced when aluminum or silicon are used. When manganese is used, clean castings result if ordinary precautions are taken in pouring.

It is customary to add the manganese in the form of manganese-copper alloy, which contains 30 per cent manganese and 70 per cent copper. The addition to nickel silver is about 3 or 4 ounces of the alloy per 100 pounds of the mixture, which equals about .06 to .075 per cent manganese.

In such alloys as cupro-nickel the amount of manganese-copper should be almost doubled and about 6 or 8 ounces are added. This quantity introduces about .12 to .15 per cent manganese and to certain grades of nickel copper .25 per cent manganese is added. The manganese-copper should be introduced into the mixture after all the other metals have been melted and the whole well stirred. The mixture should now be left for a few minutes so as to give the manganese time to act. It will be found that manganese gives excellent results in nickel alloys. It is well known that certain manufacturers of cupro-nickel owe their success in the manufacture of this alloy to the manganese which they use.

Another important feature in the use of manganese is its affinity for sulphur. It has been found that manganese has the greatest affinity for sulphur of any metal, and when introduced into a mixture which contains it, the two combine and form a non-metallic substance, sulphide of manganese, which rises to the top of the metal as slag.

As sulphur is frequently present in cupro-nickel alloys either by absorption from the products of combustion or from that which exists in the nickel itself, the value of the affinity of sulphur for manganese will readily be appreceiated.

It is the writer's opinion that more attention should be given to the question of sulphur in non-ferrous mixtures, particularly at the present time when raw materials and fuel are not generally of as high quality as they were prior to the war.

From the above it will be seen that manganese acts principally as a deoxidizer or desulphurizer as the case may be. What applies to nickel-silver or cupro-nickel also applies to other types of non-ferrous mixtures in varying degree. That is to say practically all the metals entering into the products of non-ferrous metallurgy absorb a certain amount of oxygen during the process of melting, producing oxides, which if not removed cause disastrous results.

In the casting of brass it has been shown that manganese acts best when there is a high content of zinc. On the other hand in a red brass, phosphorus is used with excellent results due to the fact that it causes the tin with which it alloys more readily, to assume a crystalline structure and produces a more homogeneous casting. It might be of interest to mention, that quite a number of concerns are experimenting with manganese to make use of its hardening effect and so decrease the amount of tin used in certain mixtures.

The writer is unable at the present moment to give statistics showing the tremendous increase in the use of manganese but it certainly is very considerable. This has been brought about to a great extent by the tremendous demand for munitions, etc., as manganese

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is used not only in the various mixtures previously mentioned, but also in nichrome, monel metal, aluminum and stellite, the well-known high-speed cutting tool, as well as other less well-known mixtures. Probably the most recent use for manganese is in a certain non-ferrous mixture which is used for the production of the necessary charcoal for gas masks by the carbonization of fruit stones.

THE ART OF ENGRAVING AND EMBOSSING

An Exhaustive Article Dealing with the Production of Artistic Effects in Metal Work Written for The Metal Industry by Easy Way.

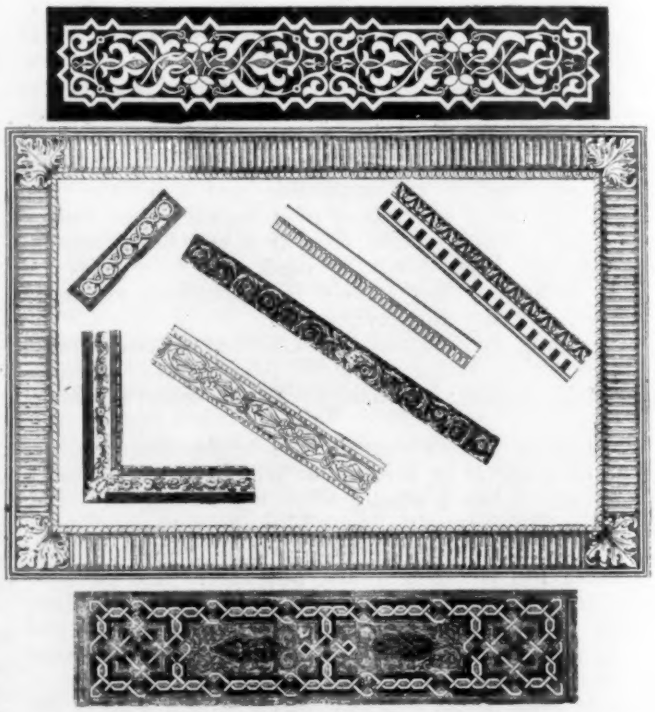
(FIFTH PAPER)

The articulation of the leaves and flowers is represented by simple wiggle cuts over a matt ground, which are produced by the graver or threader. However, a matting punch is used when the thickness of metal is substantial enough to resist the hammer blows. There should be nothing in the design requiring rounded cuts and the passage for the tools in clearing out the ground or matted surface is purely a self-conscious thought that will germinate while producing an idea to be translated and transferred on to the metal. After having traced the full-size design the plate is washed, as previously explained, of wax or grease. Then, with the graver outline the whole of the leaves, etc., keeping well on the outside of the tracing. Ignore all minor detail for the present, only blocking out the design in mass. No outline need be cut for the margin at present.

It is customary to begin this class of work at the left hand bottom corner, taking care not to cut off parts of the leaves in the process. Begin a little above the corner at the bottom and leave all a little below that at the top. The border will be formed later, remembering to always cut as much as possible on the uphill direction, which is governed by the left hand tilting the work. After the slow and quick curves have been cut around the design, it leaves the ground in a rough state, which must be finished later on. Now take the graver, which should be well sharpened, and cut down the outline as accurately as possible to the depth of the ground and proceed to clear out the "rags" between the design and the ground all around it with one of the grounder tools, using the largest one possible. After this is finished, the border which serves as a frame and at the same time an ornament, is produced by a threading tool and graver or whatever other tools may be required should the design contain a scroll or flourish, but uniformity and simplicity at this time cannot be excelled, because the effect of flanged lines and smooth bright cutting by sharp tools as readily understood makes a beautiful heavy ground that throws up an ornament to a wonderful extent and will ever continue to be the most popular. But should scrolls and flourishes be attempted the greatest care must be exercised or the intended effect is spoiled by uneaven or broken lines. The best secret of success, however, with scrolls and flourishes is to overcome an uncomfortable, overdone, elaborate novelty that will lack poise, as it is this sameness that kills a stimulated expression and becomes stale and flat.

A few designs for borders are submitted at this time as a study and will serve as ideas for others as good examples and assist the operator in using his hands; in other words he will become accustomed to the use of tools and be able to guide them with accuracy, which are two very important acquisitions. The beginner should not attempt making the work too deep until well accustomed to the patterns and has obtained a good command of the tools, as a low relief or shallow design is far easier to work and does not require so much labor to execute. Of course, it is not as effective as a design worked in deeper, nevertheless work of this kind, when well finished, has a very pleasing effect. The few patterns of borders here shown should be sufficient to enable a workman to both execute this work and form his own designs.

Experience, however, must be largely used in deciding such questions. Thus, it often pays to take some part which has been in service and proven satisfactory and determine the weight of the coating. Then, unless the coating is obviously much too heavy, definite information is obtained as to the weight which will give the desired service. Knowing this, caution should be the guide in deciding how much this may be cut down. It is often instructive, too, to take some part which has failed in service and find out the weight of deposit. This figure might then serve as a sort of lower limit, which should not be approached too closely.



SOME BORDER DESIGNS FOR THE STUDENT OF ENGRAVING.

It was noted above that oxidized finishes are often produced with very light deposits of copper. That these can be too light, however, recently came to the writer's attention. A certain plater was having much trouble with his oxidized copper, which he attributed to the liver of sulphur oxidizing solution. A little investigation showed, however, that his copper "flash" was altogether too light, so much so that most of it was being eaten off by the oxidizing solution, producing very unsatisfactory results. Perhaps this case is a little unusual, but it illustrates the necessity of really

knowing how heavy a deposit you are getting instead of guessing at it.

ARTISTIC ENGRAVING.

Work that is more difficult and artistic will now be taken up, namely: Monograms, crest work, inlaid ornamentation, foliage work and contour designs, etc. Contours or rounding and modeling, of course, correspond to

EXAMPLE OF ARTISTIC ENGRAVING.

light and shade, but plain graving and cavocutting is simple sketching. Animals or a human figure, a vase, flowers or vines may be thus engraved, the only condition being that the outline shall be broad and bold. However, care should be exercised not to make too many lines, especially fine ones. In all cases avoid de-

A FINE SPECIMEN OF ECCLESIASTICAL ENGRAVING.

tail and make the design as simple as possible. Thus, when outlining an animal and it is clearly indicated what the object is meant to be, enough has been accomplished for in all sketching the golden rule is to gave as much representation with as little work as possible. That was the original step in mediaeval engraving and repoussé work for decoration and the specimens now preserved are copied and pronounced peerless.

Compared with foliage design, the elements drawn from the animal kingdom are few, owing to the difficulty experienced in adapting them for decorative purposes and it was found advisable not to introduce them too often. The same rule that guides the selection of foliage also applies to animals. The animal forms used mostly for ornaments the lion, panther and tiger of the wild species and the horse, ox, dog and goat of the domestic tribe. The dolphin is used as a representative of ocean life because of its symbolic significance and ornamental possibilities, and in bird life the eagle reigns supreme, while other birds have been chosen mostly in an auxiliary manner, as in the enriching of an ornament when birds, reptiles, insects, cherubs and similar elements were used for naturalistic designs. The serpent forms are used principally for their symbolic meaning and the lamb generally in conjunction with the cross as a Christian ornament. The human form has been used extensively as symbolic of seasons, hours and elements such as

A SAMPLE OF VERY FINE INTRICATE DESIGN WORK IN ENGRAVING.

virtues and vices, good and evil, strength and grace and the gods have always been represented as glorified men. Angels and devils also have partaken of man's physical form, it having been represented very often solely on account of its decorative value as being the highest possible expression of art and beauty.

(To be Continued)

CANADA'S WAR ORDERS.

According to figures compiled by the Monetary Times, Canada's war orders from the outbreak of war to the end of 1917 totaled $1,812,000,000, and during 1917 the value of munition orders totaled $338,000,000. The value of munition orders placed up to September 30 was $262,000,000, of shipbuilding orders $46,730,000, and of all orders since the outbreak of the war, including shipbuilding, $972,000,000. The number of people engaged in the munitions industry in Canada was approximately 225,000.

HARDNESS AND HARDENING

An Exhaustive Address Delivered at the September, 1917, Meeting of The British Institute of Metals

By Professor T. Turner, M.Sc., A.R.S.M. (University of Birmingham).

Hardness is a property which is of great importance in connection with the practical uses of metals. This is evidenced by the numerous methods which have been introduced from time to time for testing hardness, and also by the abundant literature which has been published on the subject. The latest contribution to this study is a "Report of the Hardness Test Research Committee of the Institution of Mechanical Engineers" (November, 1916), in connection with which a bibliography has been prepared. I have been privileged to assist in the preparation of this bibliography, which contains references to some 131 papers and other publications dealing with hardness and hardness tests. Even this list does not touch the question of hardening, which has been discussed by Sir George Beilby, Professor Edwards, Mr. McCance, the present writer, and many others. To the report above mentioned three appendices are attached, which give the views on the nature of hardness of Professor Unwin, Sir R. Hadfield, and Dr. Tutton, respectively. From these appendices, which are of great interest, it is evident that the members of the committee, and those who took part in the discussion, are not agreed upon the fundamental conceptions as to the nature and definition of that which they were endeavoring to measure.

DEFINITIONS AND MEASUREMENT OF HARDNESS

It has been frequently stated that hardness is a property which cannot be measured or readily defined. This is merely another way of saying that we have not made up our minds as to what we mean by the term "hardness," for there is little difficulty in framing a definition when once a clear mental conception is reached. That which can be accurately defined is capable of measurement.

Though so eminent an authority as the late M. F. Osmond has used the word "measurement" in connection with hardness tests (see report "Sur la Dureté: sa définition et sa mesure," Paris 1892), physicists appear to have pretty generally expressed the view that hardness cannot be measured. Professor H. Le Chatelier, in discussing the "Report of the Hardness Tests Research Committee" (page 777), admirably states this view as follows: "Two simple characteristics determined whether a quantity might be measured or not. If measurable it should satisfy the laws of equivalence and accumulation. Temperature, though it followed the law of equivalence, did not follow that of accumulation. For instance, two bodies raised to the same temperature would not give a higher temperature if brought together. So that temperature could not be measured—all that could be done was to register it on certain scales. . . . Hardness was exactly the quantity which followed neither the law of equivalence nor that of accumulation."

It may be dangerous for one who can make no claim to be a physicist to differ from so recognized an authority as Professor Le Chatelier. On the other hand, it may be inconvenient to take words which have been familiar for centuries, and to endeavor to limit their application to the specialized uses of modern science. In the present instance it may be pointed out that a property is not necessarily a quantity; and it would scarcely be urged that hardness is a quantity in the sense of the physicist. Further, it may be remembered that the word "measure" has a much wider use in our language than is suggested by the laws of equivalence and accumulation.

What we require, for practical purposes, is to be able to register hardness on a numerical scale, just as we do density, tenacity, viscosity, or other properties. For example, we determine relative density: it does not follow the law of accumulation, because if two bodies of the same density are brought together the density is not doubled—unless they are gases which can be compressed into half their original space. The determination is accurate, and similar results are obtained on repetition. Shall we say the density has been measured; or has it only been registered or determined? To the physicist the choice of a word here may be important. But the ordinary reader might be misled if he were told that the density, or the elastic limit, of a metal cannot be measured.

The definition which I myself prefer is that hardness is the property whereby a body is able to penetrate another body; and conversely, it is the property whereby a body resists being itself penetrated. This does not materially differ from the definition proposed by M. Osmond in 1892, that hardness is "resistance to permanent deformation." Sir Robert Hadfield's definition is simply "resistance to deformation." From the mechanical aspect, hardness, as so defined, will closely correspond with the "yield point" or "breaking-down point" of the material. In ductile materials, such as relatively pure metals, of which mild steel is an example, the yield point is often roughly proportional to the ultimate tensile strength. In such cases the hardness, as measured by the stress per unit of area required to produce penetration, is less than, but varies with, the tenacity. In brittle materials the yield point and the ultimate strength are practically identical: in such cases tenacity and hardness will nearly coincide. The hardness may, however, exceed the tenacity, since in a tensile test the particles are drawn away or separated from each other, while in a penetration test there is a certain amount of "backing" in the material, which tends to support the penetrating body.

With penetration tests, such as those of Brinell, in which an appreciable quantity of metal is displaced, the true hardness is not obtained, since the displaced material becomes more or less work-hardened, and another similar test on the same spot will not give the same result. The difference may, however, not be large. In wearing tests the polishing, and consequent hardening, of the rubbing surfaces on the one hand, or their disintegration on the other, may lead to quite erroneous conclusions. Theoretically, the production of a scratch of standard width, and of indefinite thinness, with the employment of an ascertained weight, would appear to most nearly meet the ideal conception. For practical purposes the requirement of a smooth surface, and the difficulty of accurately deciding the character of the scratch, has prevented the extensive use of scratching tests by engineers, though such tests are still preferred by mineralogists and other workers. The conception underlying the Brinell test is a simple one—namely, that a unit of surface will just maintain a stated pressure before being deformed. So long as the amount of deformation of the sample is not excessive, and provided the body to be tested is not brittle, the Brinell hardness number closely corresponds with true physical hardness.

RESISTANCE TO WEAR

For many purposes, however, the engineer does not really require hardness, though he asks for it. What he does desire is resistance to wear, or to deformation, or some other property or combination of properties which are of importance for the particular purpose he has in

view. Thus, if we consider a wearing or grinding test, it is necessary, if the metal is not to wear away quickly, (1) that the particles on the surface shall not be readily displaced, and (2) that the particles so displaced shall not be readily removed. Both conditions are necessary: either alone is not sufficient. Substances which are really hard do not permit of their particles being readily displaced—hence they wear well. Plastic metals do not permit of their displaced particles being readily removed—hence they too may give good wearing surfaces, though they are really very soft. The wearing properties of manganese steel, for instance, would appear to be due to two causes: (1) The relatively high natural hardness of the material itself; (2) the fact that the particles which are displaced from the surface do not come away and form a powder, but are plastically spread over other parts of the surface; they are thus capable of being repeatedly displaced, and are work-hardened before being ultimately lost.

A number of unfortunate terms have been introduced during the last few years, such as "tensile hardness," "wearing hardness," "elastic hardness," and so forth. These terms are misnomers. Thus tensile hardness is merely tenacity; but tenacity indirectly measured by some apparatus which is found to give results which, when multiplied by a suitable factor, are approximatey the same as those obtained by the tensile testing machine. This term has been almost exclusively used in connection with tests of mild steel, such as is used for constructional purposes, and for somewhat harder material as employed for rails. In such cases, as has been already pointed out, the true hardness is less than, though approximately proportional to, the ultimate tensile strength.

HARDNESS OF PURE METALS

If attention were confined to the pure metals in their cast, annealed, or unwrought condition, the question would be much simplified, for the hardness varies inversely as the atomic volume. In other words, the hardness increases as the number of atoms in a unit space increases. Mr. S. W. Smith has also shown that with liquid metals surface tension varies inversely as some function of the atomic volume,* while Dr. F. C. Thompson suggests that the elastic limit is dependent upon surface tension. Dr. Tutton has shown that with a number of substances other than metals, the hardness varies as the molecular volume, provided always that similar materials are compared. Dr. Tutton has also pointed out that it may be anticipated in crystallized substances, owing to the arrangement of atoms in the crystals, there may be some differences of hardness in different directions in the same crystal.

It is frequently stated that pure metals are not to be obtained commercially; but it is worthy of remark how exceedingly pure some commercial samples of metal really are. Thus lead, tin, and zinc are sold by the ton with an analysis which shows 99.95 per cent. of the respective metal, and only one part in two thousand of total impurity. But for the majority of purposes pure metals are too soft, and must be hardened in some way.

METHODS OF HARDENING

There are three methods whereby the hardness of a pure metal may be increased: (1) by alloying; (2) by cold working; (3) by chilling.

Chilling may be regarded as a combination or variation of the first two methods. It may lead to the setting up of internal strains, which really produce the effect of cold work; or it may change the chemical composition of an alloy by causing some constituent to remain in solution, or even prevent a constituent from going into solution. The hardening of steel, and the softening of certain bronzes, by chilling, are examples of this effect on internal composition. Ultimately, therefore, metals or alloys can only be hardened by a change of composition or by strain.

When we add to one metal another metal, or other element, and allow the product to solidify, the result is a mixture, a compound, a eutectic, or a solid solution. The useful ductile alloys are, almost without exception, solid solutions. Since this fact has been recognized, special attention has been given to the nature and properties of metallic solid solutions, and some important generalizations are now fairly well known.*

HARDNESS OF SOLID SOLUTION

As we pass from either end of a series of solid solutions towards the centre of the series it will be found that the hardness, the limit of elasticity, and the tensile strength increase, but the ductility (as measured by the extension and the reduction of area) and the electrical conductivity decrease. The melting point usually changes fairly regularly throughout the series. These facts for a series of solid solutions of a metal A, and any other

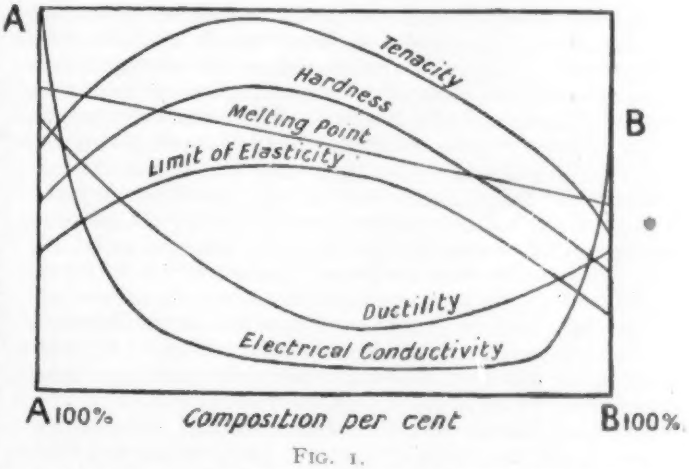


FIG. 1.
A DIAGRAMMATIC REPRESENTATION OF MECHANICAL PROPERTIES OF SOLID SOLUTIONS OF A METAL A AND A NON-METAL B.

metal, metallic compound, or non-metal B, which forms a series of solid solutions with the metal A, may be diagrammatically represented in the simplest possible manner, as in Fig. 1.

If a series of solid solutions be interrupted by the presence of compounds, or of eutectics, these will be indicated by irregularities in the hardness and other physical properties, at such points as correspond with the end of the series in the respective cases.

It will thus be seen that it is possible to harden either constituent by addition of moderate proportions of the other. At the same time the material becomes less ductile—in other words, more brittle. A point is frequently reached at which the tenacity can no longer be increased with safety, owing to the continued increase in brittleness. But the metals we add do not necessarily diminish the ductility in their alloys at the same rate as they increase the tensile strength. For example, nickel, copper, manganese, or chromium may be added to steel in such proportions that the improvement in tenacity is much greater than the deterioration in ductility. Hence the application

*"Journal of the Institute of Metals," No. 2, 1914, vol. xi, p. 206.

*See Kurnakow and Shemtschushny, "Journal of the Russian Physical Chemical Society, 1908, vol. xi, p. 1067; also Dr. Desch, "The Hardness of Solid Solutions," Faraday Society Discussion, 1914, p. 46.

of such metals, in suitable proportions, in steels for special purposes.

In the copper alloys the same general principles are adopted. The proportion of zinc which can be added to copper, in order to strengthen it, is limited by the loss of ductility, having regard to the purpose in view. For ductile brasses, as is well known, the limit of zinc is usually about 30 per cent. Small quantities of iron or of manganese may increase the tenacity more rapidly than they deteriorate the ductility. Of this we have examples in the manganese and iron brasses.

It is stated in the "Ninth Report of the Alloys Research Committee" (page 133), that the effect of adding manganese to an alloy of copper and aluminium was to raise its yield-point and tensile strength without reducing its ductility to a corresponding extent. With increased knowledge of the effects produced by relatively small additions of the less common metals to our alloys, it is probable that a useful field will be opened for increasing their hardness without producing brittleness.*

HARDENING BY COLD WORK

Turning now to the hardening of metals by cold working, it is well known, to those interested in the wrought metal industries, that the effect of such processes upon the mechanical properties of many metals and alloys is remarkable. The yield point and tensile strength are raised, while the elongation and reduction in area (or ductility) are markedly lowered. The electrical conductivity is only slightly affected. Further work put upon the metal causes it to fracture. By suitable annealing the material may be rendered soft and ductile as before. The material in its wrought state not only has greater strength, but is also harder than the original metal or alloy. But when that hardness is measured by different instruments, such as the sclerometer, the scleroscope, or the Brinell tester, it is not found that the values obtained are in agreement. Hence the hardness produced by cold working is different in kind from that resulting from the alloying we have previously discussed.

It might perhaps be assumed that rolling, hammering, or pressing a metal would render it more dense, and that the observed increase of hardness is due to such added density. But any change of density due to mechanical processes is far too small to permit of being explained on the principle of atomic volume. Further, as a matter of fact, the change is ultimately in the opposite direction. The first result of pressure is to close up any pores, cracks, or blowholes, and thus to increase the apparent density; hence bars are usually more dense than the ingots from which they have been rolled. The subsequent effect of cold working is to slightly but appreciably diminish the relative density of the worked material. It is important to consider how this change is brought about.

If a piece of metal be stressed to any extent below its elastic limit, and the stress is removed, the metal returns to its original form and volume, and no hardening results. But if the stress be increased, so that the elastic limit is passed, permanent stretching or strain results, and the metal becomes worked hard. This stretching or deformation occurs, as has been shown by Rosenhain and other workers, chiefly, if not entirely, by shearing slip along planes of internal crystal symmetry. It matters not whether the force be applied in the form of a pull of a tensile machine, a blow as from a hammer, or pressure as in a compression test; there is no hardening unless there has been shearing flow, and this flow generally, if not universally, results in a small but appreciable diminution of density.† We may profitably inquire how this change of density originates.

CAUSE OF WORK HARDNESS

If we imagine a solid crystal which is under strain, as a result of which shear occurs along a plane of crystal symmetry, it will be evident that at the moment the particles are pushed asunder, and caused to slide upon each other, they were clinging to each other, and were separated only with difficulty, and by what we usually call a "pull" of sufficient strength. The materials thus clinging to each other, and forcibly separated, were in a state of tension. It would therefore appear that the intervening layer of "amorphous" material cannot be in a normal or unstrained condition, neither can it be in compression; it must therefore be in a state of tension. When a bar of metal is in tension it becomes longer, and the extension is proportional to the stress applied. But in such a case the bar becomes thinner as it elongates; so the extension must not be regarded as indicating any volume change. Yet doubtless there is a small, but nevertheless real, volume change when a bar is stretched or compressed. It is just as real as the expansion of a gas on reducing the pressure, though almost indefinitely smaller in amount. It is this volume change, due to tension, which leads to the observed diminution of density in wrought metals.

That diminution of density does result from cold working has been shown experimentally by many observers. Thus Brunton found that in drawing steel wire its specific gravity could be increased from 7.768 to 7.998 by cold work, but that when this point was reached further drawing caused the density to decrease. Kahlbaum has shown that the density of platinum wire is reduced from 21.43 to 21.41 by wire drawing. Lowry and Parker found that metallic filings are in a worked hard condition, and that by annealing their density increased. Professor Lea of Birmingham has found that the density of mild steel is diminished if it be subjected to compressive stress which leads to distortion. Lastly, it may be recalled that Professor Heyn, in his May Lecture,* has proved that in cold-rolled bars the outside is in tension and the inside in compression.

HARDNESS AND TENSION.

When steel, which contains carbon, is hardened by means of rapid cooling, it is well known that the density of the hard steel is less than that of the soft or annealed hypothesis that hardness corresponds with a condition of material. Hence Professor J. W. Langley suggested the internal tension, and softness with the absence of tension. H. E. Field,‡ a little later, suggested that the hardening of iron is due to the particles being forced and held farther and farther apart, whether by heat or mechanical means. W. Metcalf, in discussing Field's paper, stated that cold working reduces specific gravity, while it increases the hardness, tensile, transverse, and torsional strength. He has also proved by actual measurement and weighing, on a commercial scale, that the density of cold-rolled wrought iron bars was less than that of the original metal.

These tests were conducted at Messrs. Jones & Laughlin's works when Mr. Metcalf was acting as assistant to Major W. Wade. Specific gravity tests showed that the cold-rolled iron was less dense than the hot-rolled bars. Major W. Wade. Specific gravity tests showed that the ranged for a number of samples to be weighed, without vouchsafing any reason. Mr. Metcalf's results agreed with those of Major Wade, but they were so contrary to what

*P. Ludwik has recently published a research dealing with the hardness of a large number of alloys (Abstract, "The Ironmonger," April 7, 1917).

‡"Journal of the Institute of Metals," No. 2, 1915, vol. xiv., pp. 145-149.

†I understand that when coinage blanks are pressed there is an increase of density. If this is so it must be regarded as a special case, as the specimen is practically in a closed box and is not free to expand.

was then the general theory that further tests were made. Hot-rolled bars were pickled, cleaned, carefully measured, and the cubic contents calculated. They were then cold rolled and carefully measured, when it was found that the increase of length more than compensated for the reduction in diameter. Many similar examples could readily be found.

FILMS IN TENSION.

The conception of stretched layers existing between the particles of a cold-worked metal, or at the surface of a polished metal, has led various thinkers, and especially our President, Sir George Beilby, to recognize the similarity which must exist between such layers, and the surface tension with which we are familiar in liquids. This surface tension leads to the formation of so strong a skin upon water that a fly can walk upon it, or a greased needle float. But it would be unwise to assume, because there are some obvious similarities, that therefore all the laws which are applicable in the one case are equally true in the other.

It is evident that if a membrane is to be stretched there must be some body to which it can be attached, or to which it can adhere. The head of a drum is an illustration of this fact. In the case of a liquid drop the skin extends all around; but in other instances the film support is supplied by the sides of the containing vessel. It is interesting to inquire how the planes can remain stretched in a solid body, such as a cold-worked metal.

If we could imagine the extreme case of the whole of the crystalline material being converted into the amorphous state, and all the planes being parallel to the length of the body, we should have an impossible condition, since all the layers would be in extension, with nothing to keep them extended. This could only exist with a body acting under external tensile stress.

Such a body would be incapable of shearing strain; its yield point and its ultimate stress would coincide; it would be brittle like glass. Glass is brittle because there are no planes of shear. But in the case of a metal or alloy consisting of mixed crystals, differently oriented, strain leads to the production of a series of slip planes in each crystal aggregate. Adjoining areas, as viewed in a microscopic section, have their planes at various angles to each other, owing to the different arrangement of the component micro-crystals in each crystal aggregate. These planes, or thin films of amorphous material, may be regarded as being held in tension either by the rigidity of the crystal envelope (or cement), or by the mass of the unchanged material, or by both of these. But in ordinary mechanical processes, such as rolling, hammering or drawing, we have not to deal with a single deformation, and one set of shearing planes in each crystal grain. Deformation follows deformation, and planes are set up in many directions. These slip planes cross and recross each other, their direction being limited only by the necessities of crystal symmetry. A section thus shows a network of crossing lines, each of which we assume to correspond with an extremely thin layer in tension. We have in each section an intricate network, which is held together by tightly stretched strings or tapes, and supported by intervening, unaltered crystalline material. When we remember the great strength of a lattice girder, or of woven wire, we can more readily understand how these extremely thin layers of amorphous material, all of which are in tension, are able to confer great tenacity and hardness upon a worked ductile metal. The fact, referred to by Rosenhain, that metal which has been hardened against tension is softened against compression, is entirely in harmony with the foregoing explanation. But since the whole of the crystalline material never is, and never can be, completely converted into the amorphous condition, it follows that there must be unequal hardness and unequal tenacity throughout the various portions of the worked-hard material.

Herein lies the essential difference in the character of the added hardness which is conferred by alloying and by cold working respectively. In the case of alloying we deal as a rule with a solid solution, which as a result of osmotic pressure is in a state of molecular tension, and every unit of which is of similar composition. It is true that with castings "coreing" occurs, but that does not really affect the argument. With a solid solution various methods of testing hardness should give results which are in general agreement. Worked hard metals, on the other hand, are less uniform in hardness, and if tested in various ways may give different results, depending upon the character of test selected.

LIMITS OF WORK HARDNENING.

It may be of interest to consider to what extent a metal may be hardened, or have its tenacity increased, as a result of cold working. It is difficult to suppose that any means could be found whereby the tenacity of a film of metal could be made to exceed the tenacity of a thin polished film at the surface—that is to say, to exceed the surface tension. Now Quincke calculated the capillarity constant of certain solid metals and alloys, or, in other words, the pull exerted upon one millimetre of surface. With iron, silver and gold the ratios of the hard to the annealed state were about 3 or 4 to 1. With certain alloys it was less than 2. With steel it was about 7 to 1. These values must be regarded as rough approximations, and merely indicate the kind of numbers with which we have to deal. What they do show is that even if the whole of a sample of metal could be converted into material having the properties of a surface film, there is a definite limit to the hardness which could be imparted by the processes of cold working. In other words, after a certain point had been reached further work would not confer greater hardness, but would cause fracture.

But if it be true, as before suggested, that it is impossible to convert the whole of any metal into thin films, in a parallel direction, then it would follow that the attainable limit for increased hardness is below the figures which have been previously mentioned. In practice, for example, cast copper has a tenacity of from about 10 to 14 tons per sq. in. When it has been drawn as far as is mechanically possible, in view of the purposes to which it is to be applied, its tenacity is from about 24 to 28 tons. Roughly, therefore, its tenacity has been doubled. In some cases less than this is possible; in exceptional cases more can be obtained. But always the maximum is only a small multiple of the original.

Even if we had information as to the proportion of the mass which had been converted in stretched films, it would not appear possible to calculate what the increased hardness or tenacity should be, and so check it by experiment. For if we accept the view that these planes are like so many strong bands passing through the material, that they are of varying length, and crossing and interlocking with each other at an indefinite variety of angles, it will be seen that we are dealing with a system of astonishing complexity which none of the usual methods of examining stresses would be able to unravel.

In a recent paper by P. Ludwik,* of which I have only as yet seen an abstract, the view is expressed that the phenomena of cold working are not explicable by

*"International Journal of Metallography," 1916, vol. viii, p. 53.

Sir George Beilby's amorphous hypothesis, or by Tamman's translation hypothesis. Ludwik draws attention to the fact, which had already been stated by Professor H. M. Howe, and carefully studied by Matthewson, that the greater the amount of mechanical work the lower is the temperature at which softening takes place on annealing. In the foregoing remarks I have endeavored to show that if it be assumed that the amorphous material exists in the condition of thin films, in tension, akin to surface films of liquids, then the results of cold working can be readily understood. And it would appear to follow that the more numerous these films are, and the more they are strained, the more readily will they tend to adjust themselves as the temperature is raised.

ALLOYS OF SILICON AND COPPER AND THEIR HIGH ELECTRICAL CONDUCTIVITY

An Interesting Microscopical Examination of This Well-Known Deoxidizer.

Written for The Metal Industry, By James Scott.

Owing to its high electrical conductivity, silico-bronze, containing copper, tin, and silicon, has largely superseded other alloys and single metals for the manufacture of telegraph, telephone, and similar wires.

This exceptional merit is conferred upon it chiefly by the presence of silicon, an abundant element of very refractory character. The breaking strain, or resistance to mechanical forces, is also increased considerably beyond that common to more ordinary wires, and this must be borne in mind.

The raw material for the silico-bronze is generally in the form of silico-copper, or as it is alternatively called, cuprosilicon. Of course, each maker has his preferences in the matter of selecting certain alloys for the basis of silico-bronze, and so forth; and we must be content with gaining a rather cursory insight into the behavior of the respective components.

The exact nature of the silico-copper series of alloys is not fully understood, a lack of knowledge which is due principally to the comparatively meagre extent of investigation which has been accorded to them. But sufficient details have been observed to prove the reasons for the high qualities possessed by these kinds of alloys. They are occasioned by the influence of the silicon upon the copper, the tenacity of which is so improved that the latter, while retaining its individual attributes, is wonderfully increased in tensile strength.

FIG. 1.—ABOUT ONE TWENTY-FOURTH INCH OF THE SURFACE OF FUSED SILICON, MAGNIFIED, SHOWING ITS CRYSTALLINE STRUCTURE.

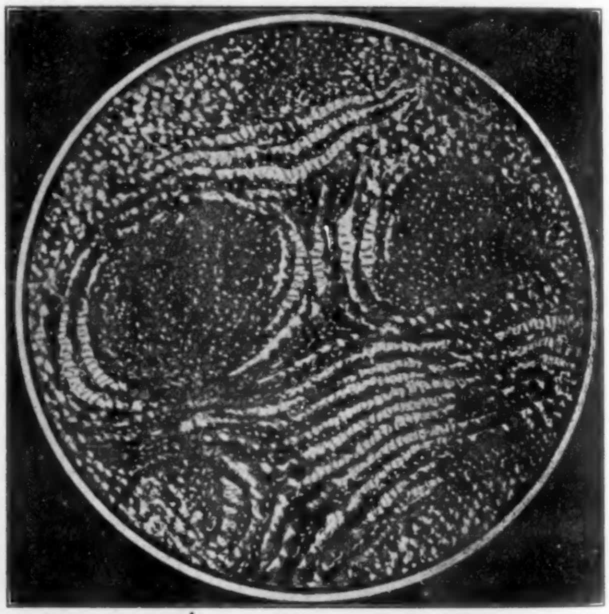


FIG. 2.—ABOUT ONE TWENTY-FOURTH INCH OF THE SURFACE OF AN ALLOY OF COPPER WITH FIFTEEN PER CENT. OF SILICON, MAGNIFIED, SHOWING ITS CORRUGATED ENCIRCLED MASSES OF VERY FINE PARTICLES.

The passage of electricity through copper wires exposed to prevalent atmospherical conditions gradually helps to corrode the surface to a red or black friable oxide, thereby seriously hindering the steady continuance and potency of the current, which travels more conveniently, if not exclusively, outside the metal than it does internally. Silicon-bronze wire is not subject to these disintegrating changes, and this fact must be associated with the influence of the silicon, even though its proportion may be very small.

Silicon is obtainable in two distinct modifications or allotropic forms, the one being as an amorphous brown powder, and the other, which is of more importance, as a dense black, crystalline mass. Amorphous silicon can be procured by means of many chemical reactions; whereas the evolution of crystalline silicon depends on the result of fusion by heat. The latter tends to crystallise in the hexagonal system, and is shown magnified in Fig. 1. Because of its somewhat lustrous appearance and color, it is often termed graphitoid silicon. It is one of the hardest and most durable elements known, and is widely referred to as a metalloid through its quasi-metallic condition and intimate connection with metals and their ores.

Some scientists claim that silicon can be produced in a

third modification, which they call adamantine, but this stage is not so perfectly distinct as the preceding ones, and must be regarded simply as a variety of the graphitoid or crystalline one.

In conjunction with oxygen, silicon constitutes silicon-oxide, or silica (formerly known as silex), a compound typified by flint, sand, and quartz, the last of which is by far the purest. Silica is one of the substances with which, when it is in bulk, the metal smelter is quite familiar.

One of the main functions of silicon is that of a deoxidizer; but, however much this truth is obvious, there are undoubtedly other changes in the copper, etc., which are almost inexplicable. All founders of copper, brass, and bronze are fully aware of the obstinate persistence with which oxygen is retained in these metals or alloys. The gas is absorbed during the molten state of the metals, and when the latter cools and solidifies it is dispersed as globules which leave empty spaces or blow-holes. By using an appropriate quantity of silicon this combines with the oxygen and gives a slag, or else otherwise precludes its retention, and the alloy is rendered satisfactorily compact, instead of becoming minutely porous, and correspondingly defective. The action of silicon in this respect is not unlike that of phosphorus in copper, bronze, etc.

Only traces of silicon are necessary in order to impart this degree of efficiency to the copper. Great hardness is in this way also conferred upon brass.

From one quarter per cent to one half per cent of silicon is quite sufficient to serve as a deoxidiser in brass, bronze, and copper.

The normal grades of *silico-bronze* contain very small percentages of silicon, and about five per cent of tin along with the copper.

The alloys of silicon and copper supplied for the purpose of melting down with tin to yield silico-bronze constitute a series in which the silicon content comprises ten, fifteen, twenty, tweny-five, thirty, thirty-five, forty, forty-five, or fifty per cent. From ten to twenty per cent appears to be the most regular proportion.

Alloys containing more than five per cent of silicon are not of much *constructional* value, although they furnish the basis for the finished goods which are so greatly appreciated in quarters where they are employed. Copper is capable of dissolving silicon with moderate ease, up to four or five per cent, producing a definite solid solution. At about 855 deg. C. transitory results occur, and an additional solid solution develops.

The chemical compound Cu_3 Si shows itself as the third solid phase. This compound contains about eighty-seven and one tenth per cent of copper. There may be a eutectic mixture composed of a solid solution, and the compound Cu_3 Si with about ninety and one-twentieth per cent of copper, having a freezing temperature of about 820 deg. C.

Alloys containing beyond five per cent and up to twelve per cent silicon exhibit two heat changes in the vicinity of 800 degs. C, and 700 degs. C, respectively.

Some very beautiful pearly colors often cover the surfaces of silicon copper alloys. These effects are plainly due to the presence of the silicon, since the larger percentage there is of copper the more the shades approach towards merely greyish or reddish ones. Interesting problems are involved in these phenomena.

A close inspection of the whole series of silicon-copper alloys would be necessary before exact deduction could be tabulated, and this is quite beyond the range of a single article. The writer's aim is to enable others to form opinions from the most striking formations, and not to endeavor to impress the reader with novel ideas.

The microscopical formation of silico-copper deserves more examination than it has received. In Fig. 2 is shown the surface of an ingot containing 84 per cent of copper and 15 per cent of silicon; while in Fig. 3 is shown the outside of another ingot consisting of 75 per cent of copper and 25 per cent of silicon. It will be noticed that with the increase of silicon there is a larger amount of glistening silicon-rich constituent, some of which may be found in fractures, as clusters of geometical planes indicative of separate crystallization. These reproductions may be useful for reference among the men who have given attention to the present subject. The writer has been indebted to United Brassfounders and Engineers, Ltd., Manchester, for samples of their silico-copper alloys for the purpose of preparing the illustrations therefrom.

In these illustrations, the writer has depicted the metalloid and alloys as seen without any treatment what-

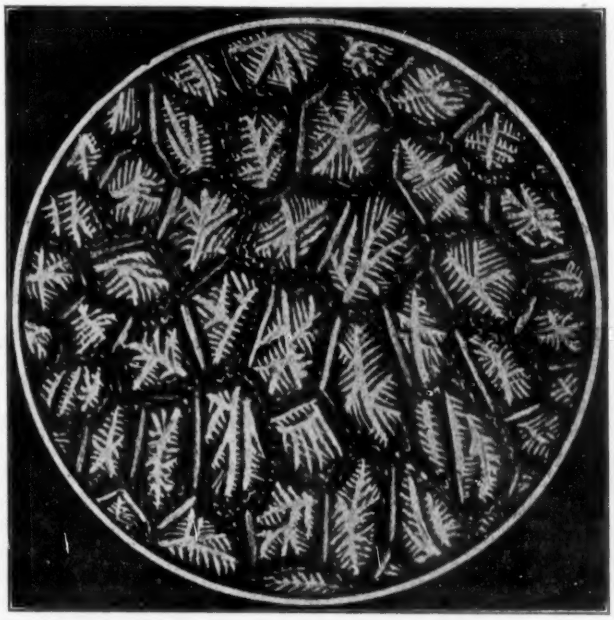


FIG. 3.—ABOUT ONE TWENTY-FOURTH INCH OF THE SURFACE OF AN ALLOY OF COPPER WITH TWENTY-FIVE PER CENT OF SILICON, MAGNIFIED, SHOWING THE DENDRITIC FACED GRANULES.

ever, either through polishing or the action of acids. In the latter case certain particles may be dissolved out, and spread over or between the others in the shape of salts of the respective ingredients; or the issues may be otherwise confused, and not altogether benefited even after water-washing in order to cleanse the alloy. Such special preparations are excellent enough in some branches of study concerning the constitution of alloys, but it is not always advisable to make observations on doctored metals, but to view their naked features alone, so as to discern what has really happened to them during the solidification process. Then, if needed, subsequent manipulation may follow; if it is considered to be likely to assist one in arriving at proper conclusions.

Beside the uses of silicon-copper previously mentioned, some grades are incorporated with castings of many kinds to hasten their solidification, and thus avoid the setting up undesirable crystallizations, and consequent brittleness or weakness of some parts, due to lack of cohesion among the grains. The practical man should not only know that distinctive benefits are ensured in this direction; but ought to be told *why* such is the case.

ELECTRO-PLATING ENGINEERING

A Series of Articles Relating to the Operations and Equipment Employed in Electro-Plating and the Reasons Therefor—Eighth Paper. This Series Began in The Metal Industry, January, 1916.

Written for The Metal Industry by Charles Blake Willmore.

CONDUCTANCE AS A FACTOR IN ROTO-PLATER DESIGN.

In the matter of roto-plater design there is a great variance of opinion as to the merits of certain types. Every plater has his preference for a certain particular design of machine, and almost every one feels that he could design a plating barrel which would be a great deal better than any on the market. The best way to settle questions concerning the superiority of any types of plating barrels is by a careful analysis of one feature at a time, obtaining mathematical expressions of such features as are susceptible of such mathematical treatment.

The following are some features which might be observed in making a study of such machines:

1. Capacity.
2. Ouput.
3. Ease of operation.
4. Ruggedness.
5. Life.
6. Electrical resistance.
7. Uniformity of operation.

Capacity and output are comparatively easy to determine, by measurement of the work held at one time, and of the work turned out in one day. The matter of ease of operation is partly a question of experience and capability of the operator and his familiarity with the mechanism. Ruggedness and life of machine can be judged in advance to a limited extent by a study of the mechanical details of construction, but an accurate determination takes time.

Electrical resistance and uniformity of operation are matters which are not so often thought of, but are nevertheless important as bearing on the total output and quality of work. Below a method is described, which has been found useful by the author, for determining and comparing the electrical resistances, and uniformity of operation of plating barrels. The method is easily applied and has the advantage of satisfactory accuracy. Further, by studying the results of the test, one can often make considerable improvement in the operation by comparatively simple changes in design.

The method will be described by use of an actual example. The apparatus used in the test was an ammeter reading to 75 amperes and graduated in ½ amperes, on which readings could be estimated to ¼ ampere, this being connected in series with the electrical circuit. Also a voltmeter reading to 10 volts and graduated in tenths of a volt, this being connected across the two power leads next to the tank.

The cross section of the drum is shown in figure 25. The corners were composed of six solid wooden pieces as shown. Five of the sides were composed of perforated bakelite sheets set into these wooden strips, and the sixth side was a solid wooden cover. On the end of the drum was a gear wheel. By counting off the gear teeth this wheel was divided into 24 parts, marking each division with a piece of chalk.

A nickel solution containing about four ounces of metal per gallon was in the tank. The drum was loaded up about one-third full with small work.

Using one edge of the tank as an index point, the drum was revolved to each of 24 different positions in turn, making a complete revolution altogether, and voltmeter and ammeter readings were taken at each position of the drum. The total resistance through the tank and drum at each of the 24 different positions was then computed from the voltage and amperage. The figures for resistance give a little better comparison than by using the amperage, because the voltage varied slightly. This data is given in the table below:

Position	Volts	Amperes	Ohms	Position	Volts	Amperes	Ohms
1	5.6	45.25	.1235	13	5.4	54.0	.1000
2	5.6	46.5	.1205	14	5.4	49.25	.1100
3	5.4	49.25	.1095	15	5.5	48.25	.1140
4	5.4	53.75	.1005	16	5.3	54.0	.0980
5	5.4	53.75	.1005	17	5.3	53.25	.0995
6	5.5	49.0	.1125	18	5.4	49.5	.1090
7	5.5	48.25	.1140	19	5.5	48.25	.1140
8	5.4	53.5	.1010	20	5.4	53.75	.1005
9	5.4	52.0	.1040	21	5.4	52.25	.1035
10	5.5	49.25	.1115	22	5.5	49.5	.1110
11	5.5	48.25	.1140	23	5.6	46.75	.1200
12	5.4	53.75	.1005	24	5.6	45.5	.1230

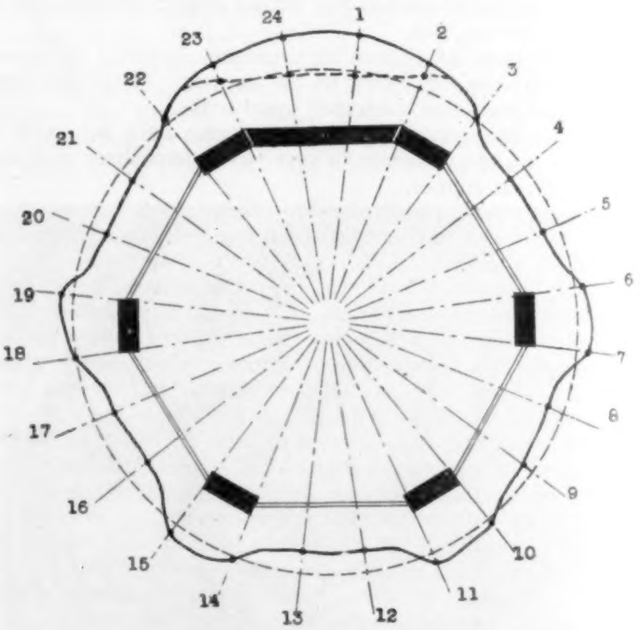


FIG. 25. A DIAGRAM SHOWING RESISTANCE THROUGH PLATING TANK AND DRUM IN 24 DIFFERENT POSITIONS.

From this data the following significant figures are taken by way of summary:

Average amperage	50.0	Average ohms ...	.1090
Maximum "	53.75	Maximum " ...	.1235
Minimum "	45.5	Minimum " ...	.0980
% variation	18.10%	% variation	21.0%

Figure 25 was produced by plotting the above figures for ohms of resistance at each position, on polar co-ordinates, that is, each of the radial lines in figure 25 represents a different position of the drum of the plating barrel. On each of these radial lines a dot is placed whose distance from the center of the figure is proportional to the ohms resistance at that position of the drum. The heavy curve was then produced by drawing lines connecting these dots representing resistances. The cross section of the drum was then superimposed on this drawing.

The average current which can be applied with good results is limited by the maximum which can be applied. Hence, it is desirable that the electrical resistance of the barrel, in its various positions, shall be as uniform as possible, in order that the average current will approach closely to the maximum.

For comparing the relative merits of different barrels from the electrical standpoint, the average resistance and the variation in resistance between the maximum and minimum are the best standards. In order that these figures shall be comparable between different barrels, several precautions must be observed in making the tests. The same solution at same temperature must be used in each tank, the test must be conducted at the same voltage, and the same amount of work must be in each barrel. Further the comparison is reliable only when the barrels are of approximately the same capacity, unless the results can be so interpreted as to take account of the differences of capacity. This would be the case if the drums in the two barrels were of the same diameter, but of different lengths. Then the resistances could be compared inversely as the lengths of the drums, with each drum filled with the same proportion of work.

In figure 25 it will be noticed that the solid wooden cover on one side of the drum causes a large increase in the resistance for that side of the drum. After the data in the preceding tables was obtained, the wooden cover was drilled full of holes. The following data was then obtained with the cover in the new shape.

Position	Volts	Amperes	Ohms.
1-A	5.5	51.5	.1065
2-A	5.5	48.25	.1140
23-A	5.5	49.25	.1120
24-A	5.4	50.00	.1080

The resistances after drilling the cover are shown by the dotted line curve at the top of figure 25. This illustrates how the above test points out ways of improving the design of the barrel.

(To be Continued)

WOMEN MUNITION WORKERS IN FRANCE

As Substitutes for Men—Improving Working Conditions.

Scientific experiments made at one of the large munition plants in Lyon showed that in the production of shells a woman operates on 900 to 1,000 shells a day, handling each piece twice (in putting it in and taking it out of the lathe), making from 1,800 to 2,000 movements with a shell weighing 6 kilos (13 pounds). She thus moves, in her day's work, a total weight of 10 to 12 tons. This work requires great precision, yet women operatives have given general satisfaction. The manufacture and repair of tools and their mountings have proved to be quite a specialty with women workers, bringing out good professional ability and keen intelligence. Before the war this work was done only by men.

Great efforts are being made now to improve woman's industrial surroundings and make her work congenial. Hygienic conditions are being improved and rest rooms provided. Extra holidays will be granted. There has been in existence since February 12, 1917, especially in the plants where raw material is made, certain allowances for expectant mothers. The amount of the allowance is fixed at 4.50 francs per day, when they rest, with a maximum of 40 days' rest, which limits the allowance to 180 francs ($36). The payment is made every Saturday, from the second Saturday following the cessation of work, and ceases from the fifth payment; that is to say, when 140 francs has been disbursed. The remaining 40 francs is paid to the workwoman 15 days after the resumption of work.

During the first three months of the operation of this regulation the total assistance disbursed amounted to 4,256 francs, divided among 35 women. On the whole the department of allowance works satisfactorily. All cases are investigated with the greatest good-will on the part of the administration, which has never refused to grant assistance to applicants. If both the father and the mother are employed at the plant the children are cared for during working hours at a specially organized infant asylum.

ADVANTAGES OF TWO-SHIFT SYSTEM.

The division of the work between two squads of women has been tried in one of the Lyon munition plants. Squad A works from 6.15 a. m. to 2.15 p. m., with an interruption of 45 minutes for the midday meal. Squad B works from 2.30 to 9.30 p. m. with an interruption of 45 minutes for the evening meal. In order that the two shifts work the same number of hours, Squad B should remain until 10.30, but as the street-car service stops after 9.30 the women on the second shift leave at that time. However, as the shifts alternate each week no discrimination results from this shorter workday for the night shift.

This division of the workday gives satisfactory results; in fact, it shows remarkable advantages from both the industrial and the social point of view. On the industrial side the women produce more in a short workday than in an extended period, besides being less inclined to absent themselves from work; further, they do not feel the fatigue so keenly. The use of night shifts, whose production is often inferior, is avoided, and at the same time a material economy is effected in the general expenses, inspection, power, lighting, etc. These deductions are confirmed by facts, as witness the following comparison of the output of two similar industries at Lyon and Bourges: Putting up of the prime holder—Bourges, 1,200 pieces in 10 hours and 15 minutes; Lyon, 1,100 to 1,150 pieces in 7 hours and 15 minutes. Marking of the rocket's body—Bourges, 1,200 pieces in 9 hours and a half; Lyon, 1,200 to 1,250 pieces in 7 hours and a quarter. Drilling the prime holder—Bourges, 3,200 pieces in 9 hours and a half; Lyon, 3,200 pieces in 7 hours and a quarter.

From the social point of view the workwoman gets important advantages from this division of the day; she is a shorter time outside her home, she can give a part of her time to household duties, and she can take care of her children if she has any. The workwomen, judging by the demand for employment, seem to appreciate this system. It is possible that this will be the way of organizing female work and a first solution of the complicated problems arising from their employment.—United States Commerce Report.

LOANS TO OUR ALLIES.

The United States has now loaned to our allies $6,091,590,000. The advances average about $400,000,000 a month.

These loans to our allies are analogous to lending weapons to friends who are aiding you in the defense of your own home. The money is being used to defeat our enemy, to maintain armies fighting side by side with our soldiers, and fleets patrolling the same oceans with our sailors.

LEAD PLATING

SOME INFORMATION REGARDING THE ELECTROLYTIC DEPOSITION OF LEAD—ISSUED AS A PRELIMINARY CIRCULAR BY THE BUREAU OF STANDARDS, WASHINGTON, D. C. SECOND AND LAST PART.

7. USE OF TABLES.

The tables for the time required to deposit a given thickness or weight of lead, have been calculated on the assumption of 100% cathode efficiency, which is, of course, never strictly realized. Since, however, under proper conditions the current efficiency in lead deposition is at least 90%, and is usually over 95%, no appreciable error will be produced if these tables are used directly. On general principles, however, and to provide against unavoidable discrepancies in measuring the current, or the area of deposit, at least 10% should be added to the figures given. Thus, for example, suppose it is desired to plate lead to an average thickness of 0.008 in. on the inside of a 155 m.m. shell, using a current density of 20 amperes per square foot. Since the area to be plated (according to Table IV.) is 1.85 square feet, a current of $1.85 \times 20 = 37$ (or for practical purposes 35) amperes should be employed, and (according to Table I.), with a current density of 20 amperes per square foot 2 hours, 48 minutes is required to produce a thickness of 0.008 in. Making an allowance of 10%, the work should be plated for 3 hours, 5 minutes.

If in the above case it was desired to increase the weight of the shell by, e.g., 10 ounces, it can be readily seen (from Table IV.) that with a total current of 35 amperes, it will require 2 hours, 6 minutes to deposit 10 ounces, or adding 10%, the plating should be conducted for about 2 hours, 19 minutes.

TABLE IV—APPROXIMATE AREA OF INSIDE OF SHELLS
(Up to Bottom of Threaded Portion)

Shell	Mark	Inside Area Sq. In.	Inside Area Sq. Ft.	Weight of Lead—Oz. for 0.001 In.	Weight of Lead—Oz. for 0.005 In.	Weight of Lead—Oz. for 0.010 In.
75 mm.	..	64	.45	0.43	2.14	4.29
4.7 inch	I	147	1.02	0.97	4.85	9.72
4.7 inch	III	134	.93	0.89	4.42	8.85
5 inch	II	156	1.09	1.04	5.20	10.40
6 inch	I	242	1.63	1.56	7.80	15.60
155 mm.	I	266	1.85	1.77	8.86	17.72
8 inch	I	403	2.80	2.68	13.40	26.80
8 inch	II	303	2.04	1.95	9.77	19.54
240 mm.	I	639	4.28	4.10	20.50	41.00

TABLE I—TIME REQUIRED FOR A THICKNESS IN INCHES OF LEAD

Current Density Amp. Sq. Ft.	Hours and Minutes 0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009	0.010
5	1:24	2:48	4:12	5:36	7:00	8:24	9:48	11:12	12:36	14:00
10	:42	1:24	2:06	2:48	3:30	4:12	4:54	5:36	6:18	7:00
15	:28	:56	1:24	1:52	2:20	2:48	3:16	3:44	4:12	4:40
20	:21	:42	1:03	1:24	1:45	2:06	2:27	2:48	3:09	3:30
25	:17	:34	:50	1:07	1:24	1:41	1:58	2:14	2:31	2:48
30	:14	:28	:42	:56	1:10	1:24	1:38	1:52	2:06	2:20
35	:12	:24	:36	:48	1:00	1:12	1:24	1:36	1:48	2:00
40	:11	:21	:32	:42	:53	1:03	1:14	1:24	1:35	1:45
45	:09	:19	:28	:37	:47	:56	1:05	1:15	1:24	1:33
50	:08	:17	:25	:34	:42	:50	:50	1:07	1:16	1:24

TABLE II—TIME REQUIRED FOR WEIGHT IN OUNCES OF LEAD

Actual Current Amp.	Hours and Minutes 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5	1:28	2:56	4:24	5:52	7:20	8:48	10:16	11:44	13:12	14:40	10:08	17:36	19:04	20:32	22:00	23:28
10	:44	1:28	2:12	2:56	3:40	4:24	5:08	5:52	6:36	7:20	8:04	8:48	9:32	10:16	11:00	11:44
15	:29	:59	1:28	1:57	2:27	2:56	3:25	3:55	4:24	4:53	5:23	5:52	6:21	6:51	7:20	7:49
20	:22	:44	1:06	1:28	1:50	2:12	2:34	2:56	3:18	3:40	4:02	4:24	4:46	5:08	5:30	5:52
25	:18	:35	:53	1:10	1:28	1:46	2:03	2:21	2:38	2:56	3:14	3:31	3:49	4:06	4:24	4:42
30	:15	:29	:44	:59	1:13	1:28	1:43	1:57	2:12	2:27	2:41	2:56	3:11	3:25	3:40	3:55
35	:13	:25	:38	:50	1:03	1:15	1:28	1:41	1:53	2:06	2:18	2:31	2:43	2:56	3:09	3:21
40	:11	:22	:33	:44	:55	1:06	1:17	1:28	1:39	1:50	2:01	2:12	2:23	2:34	2:45	2:56
45	:10	:20	:29	:39	:49	:59	1:08	1:18	1:28	1:38	1:47	1:57	2:07	2:17	2:27	2:36
50	:09	:18	:26	:35	:44	:53	1:02	1:10	1:19	1:28	1:37	1:46	1:54	2:03	2:12	2:21

TABLE III—BOOSTERS AND ADAPTERS
(Up to Top of Threads)

Mark	Outside Area Sq. In.	Outside Area Sq. Ft.	Weight of Lead—Oz. for 0.001 In.	Weight of Lead—Oz. for 0.005 In.	Weight of Lead—Oz. for 0.010 In.
IV	15	.104	0.10	0.49	0.99
V	21	.141	0.13	0.67	1.34
VI	34	.236	0.23	1.13	2.26
VII	53	.368	0.35	1.76	3.52

TABLE V—USEFUL FACTORS IN LEAD DEPOSITION

Atomic weight of lead = 207.2.
Specific gravity of lead = 11.3.
1 square foot of lead, 0.001 in. in thickness weighs 0.954 oz.
1 oz. of lead per square foot = 0.001044 in.
1 lb. of lead per square foot = 0.0167 in.

7.3 ampere hours deposit 1 oz. of lead.
1 ampere requires 7 hours and 20 minutes to deposit 1 oz. of lead.
117 ampere hours deposit 1 lb. of lead.
7.0 ampere hours per square foot deposit 0.001 in. lead.

GERMANY SHORT OF METALS

Workmen arriving in Switzerland from Germany, says a dispatch from Berne to the Paris Matin, assert that the Germans are having great difficulty in obtaining raw material for the manufacture of munitions. Several German newspapers daily publish ordinances commandeering material and ordering the melting of monuments and household objects containing metal, even handles on doors and windows being specified.

EDITORIAL

Vol. 16 New York, October, 1918 No. 10

THE METAL INDUSTRY

With Which Are Incorporated
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CONTENTS

Page
The Allied Metal Trades Congress.... 445
The Conservation of Tin.... 451
Pure Carbon Free Manganese and Manganese Copper.... 457
The Art of Engraving and Embossing (Continued).... 458
Hardness and Hardening.... 460
Alloys of Silicon and Copper and Their High Electrical Conductivity. 464
Electro-Plating Engineerings (Continued).... 466
Women Munition Workers in France.... 467
Lead Plating (Concluded).... 468
Editorials:
Metal Trades Convention.... 469
Electric Melting Furnaces.... 470
Liberty Loan 470
Individual Responsibility 470
New Book:
Scrap Metals 470
Correspondence and Discussion:
A Tour of Inspection in England and France.... 471
War Committee of Technical Societies.... 471
Shop Problems 472
Patents 474
Equipment:
New Uses for Zinc.... 476
Metallic Phosphoro 476
The Deister Concentrator.... 477
Dings' Magnetic Separator.... 477
The Cornwall Dross Converter.... 478
Associations and Societies.... 479
Personals 480
Trade News 481
Metal Market Review.... 489
Metal Prices 491
Supply Prices 493

METAL TRADE CONVENTION

The convention of the four great societies devoted to the metal trades which took place in Milwaukee, Wisconsin, during the week of October 7 to 11, 1918, has passed into history and as an occasion it well fulfilled the prophecies made by its promoters. As is told in the opening pages of this issue of THE METAL INDUSTRY, the societies participating in the 1918 convention were The American Foundrymen's Association, the Institute of Metals Division of the American Institute of Mining Engineers, the Iron and Steel Section of the American Institute of Mining Engineers and the American Malleable Castings Association, and the program of all these societies was extensive enough to keep the delegates busy and interested throughout the week.

As has been said elsewhere in this issue the keynote of the 1918 convention was patriotism. Conversation between friends bristled with it, papers read before the society meetings were full of it, discussions were based upon it and in fact the ruling spirit of the week was a determination to stand back of the administration and to do everything possible to win the war. BUT all the evidence was overwhelmingly in the direction of winning the war in the RIGHT WAY, that was: through victory by arms rather than by a diplomatic peace. There was no mistaking this determination, for it was shown on all sides in the quiet deadly intense interest shown by the visitors in the exhibition of foundry equipment and supplies held in the Milwaukee Auditorium under the auspices of the exhibition committee of the American Foundrymen's Association. While the attendance might not be said to be fully up to that of former years in point of numbers, it greatly exceeded in buying power the attendance of any exhibition yet held.

In comparison with the exhibition held in former years the following figures will show that this feature of the Foundrymen's Convention has a steady, healthy growth: In Cincinnati, Ohio, in 1909, total exhibitors, 68; Detroit, Michigan, 1910, 84; Pittsburgh, Pennsylvania, 1911, 132; Buffalo, New York, 1912, 120; Chicago, Illinois, 1913, 156; 1914, 154; Atlantic City, New Jersey, 1915, 108; Cleveland, Ohio, 1916, 146; Boston, Massachussetts, 1917, 148; Milwaukee, Wisconsin, 1918, 192.

This exhibition, then, in point of total exhibits and diversity of machines and equipment shown, was the largest and most important of them all.

There is every reason to believe, though it is too early to get any definite figures, that the 1918 exhibition will prove to be more remunerative in the amount of interest aroused and actual business done than any exhibition yet held. Of course the educational value of the various societies' meetings cannot be estimated—that is a question to be settled only by each member for himself—but, however, by a study of the material included in the literary program we should say that no one could fail to feel amply repaid for the expenditure of time and money involved in the trip to Milwaukee.

ELECTRIC MELTING FURNACES

The electric metal melting furnace has arrived and is now a commercial proposition worthy of being entertained by the metal melter. THE METAL INDUSTRY in 1909, in an article describing the various types of melting furnaces as then in use, summed up by stating that the ideal furnace for melting metal and particularly those metal mixtures involving the use of volatile compounds was the electric furnace. The prediction was then made that whenever electrical energy could be produced at a rate low enough to compete with other fuels, then the proper type of electrically operated furnace would be produced. That prediction is now fulfilled and the electric melting furnace is here.

At present as is told in the article published in the August, 1918, of THE METAL INDUSTRY there are three distinct types of electric melting furnaces on the market, the induction, the resistor and the arc type. All three types have their strong advocates and each type of furnace undoubtedly has its own special field of usefulness.

A recent trip through some of the largest metal melting plants in the country convinces us that the electric furnace is regarded as being established and it is only a matter of a short time before it will be included as a regular unit of equipment. A satisfactory feature concerning electric furnace business at present is the fact that furnaces of different types are being installed side by side at the same plants. This, of course, will afford a means to a fair and impartial comparison as to the best type for certain purposes.

The advantages of a successful electric furnace, be it either induction, resistor or arc type, over the use of coal or coke fuel are so apparent that it is hardly necessary to recount them. It seems to us, however, that in view of the serious labor shortage that attention should be called to the claims of the furnace manufacturers; **"That no skilled help is needed to operate them!"** The melting conditions having been so standardized that it merely means a matter of time to produce uniform product and homogeneous alloys. Then, too, it seems that the elimination of the expensive and troublesome metal reclaiming plant should be hailed with joy.

In these days, of metal conservation does it not seem a pity to have to mix metal, cinders, firebrick, cement and dirt together and then have to spend time and money to unmix them? A third great advantage, of course, is the saving of zinc due to volatilization when metal is melted with excess of draft. In the electric furnace this does not occur or is at a minimum and the tenor of the mixture desired is kept intact.

It is too early in the life of electric melting furnaces to obtain much authentic data as to real costs and comparative economy obtained by the use of these furnaces as against furnaces using all other types of fuel. We are assured, however, both by some users and manufacturers that satisfactory results are being obtained due in large measure to the production of electrical energy by cheap water power.

INDIVIDUAL RESPONSIBILITY

This war is to be won not by one man or one thousand men or one million men, or one million people. It is to be won by the united efforts of the individuals of many nations.

Every American citizen has an individual duty to perform, an individual share of the responsibility. The more powerful and effective the American forces are the shorter will be the war, and the shorter the war the fewer lives lost, the greater the number of American soldiers who will return home victorious.

Every American who economizes in consumption of material, who increases production, who saves and lends savings to the Government, does something to help win the war.

PUBLICATION DELAYED

Owing to a strike or a disagreement between the press feeders and the printers of the printing shops of New York City, which occurred October 19, this issue of THE METAL INDUSTRY has been delayed. We, of course, deeply regret the inconvenience caused any of our readers, due to their failure to receive the journal at the usual time. The trouble has not been of our making, nor have we had in any way anything to do with it. We simply worked as hard as we could to get the journal to our subscribers, but the fates were against it, so we have to make this explanation for our belated appearance.

NEW BOOKS

Scrap Metals—By George H. Manlove and Old Metals by Charles Vickers. Size 5½ by 8 inches. 270 pages, including index. Bound in boards. Published by the Penton Publishing Company. For sale by THE METAL INDUSTRY

This work, which is in reality two books in one, the Scrap Metals in which iron and steel exclusively are treated, and Old Metals, constituting the latter portion of the book, which covers copper, red and yellow brass, tin, lead and aluminum scrap. Probably the portion that would most interest readers of THE METAL INDUSTRY will be found in the old metals part of the book, beginning at page 219 and continuing to 278 inclusive. This part of the work is composed of eighteen chapters, which are full of extremely practical and commercial information regarding these old metals.

CORRESPONDENCE AND DISCUSSION

WE CORDIALLY INVITE CRITICISMS OF ARTICLES PUBLISHED IN THE METAL INDUSTRY

A TOUR OF INSPECTION

To the Editor of THE METAL INDUSTRY:

Brigadier General Samuel McRoberts, head of the Procurement Division, Ordnance Department, U. S. A., has just returned to Washington from a two months' tour of inspection in England and France. On his return trip General McRoberts flew from Paris to London in an airship.

Declaring that the Browning gun is now being delivered in quantity to the American forces in France, General McRoberts said that the gun has thus far so successfully met the various tests imposed upon it over there that the British and French Governments have asked that any surplus number produced be made available for use by the British and French armies.

Regarding the U. S. Model 1917 rifle being made for the American soldiers, he said:

"This rifle has won the hearty indorsement of our soldiers who have tried it out in battle. It is proving to be an all-round practical weapon for actual fighting, and the soldiers are enthusiastic over its performance."

Asked concerning his observations of ordnance material captured from the Germans in recent months, he said:

"We were particularly interested to find out whether this captured material showed any improvements or changes in type. As far as we could learn the trench mortars, machine guns and artillery taken from the enemy in recent operations show nothing in the way of new ideas or striking improvements, nor any particular superiority over the Allies. On the other hand, it was interesting to note by examination of the captured pieces that the enemy, wherever possible, is using substitutes for the metals other than steel, notably, for brass and copper. Where it is essential to use these metals he uses them, but the use of the substitutes elsewhere indicates the necessity he is under of conserving carefully his supply of copper and brass.

Although refraining for obvious reasons from discussing the quantities or types of ordnance material which the United States will be called upon to produce in the future, General McRoberts declared that he had brought back with him the knowledge that the needs along this line will be tremendous. During the time he was abroad he visited the ordnance factories in England, and after inspecting the French and American fronts in France, he went over the lines of communication back from the American front to the ports of debarkation.

"The operations of the Service of Supply," he said, "are on a tremendous scale. While the work is not as orderly as that of an established institution—and it should not be—it is effective and flexible. Although there is still a great deal to be done, I was gratified by what I saw."

Asked as to his impressions of the morale of the American troops, he said: "Nothing that has been printed as to the favorable impression made by the American soldier in France has been exaggerated. It is truly remarkable. Not only has he won the admiration of the French people, but likewise that of the French and British officers and men and of the British colonial troops. British and French officers constantly remark on the fact that the American soldier seems not only to have enthusiasm but a purposeful confidence and idealism that is inspiring. And his unusual ability to affiliate easily with the people, and the allied troops have won for him widespread popularity. More than that, he has demonstrated his capacity as a soldier.

"I crossed going over with a large ship filled to capacity with American soldiers. A British colonel on board who had made many trips on transports carrying soldiers to India, Africa and other British colonies, told me that he had never seen such discipline among troops confined to close quarters as that shown by these American troops. The same observation is made among allied officers in France. Ours is called a 'well-behaved army.'"

Sevellan Brown, Captain Ordnance Department, U. S. A.
Technical Press Branch.

Washington, D. C., October 3, 1918.

WAR COMMITTEE OF TECHNICAL SOCIETIES

TO THE EDITOR OF THE METAL INDUSTRY.

The men who, at the call of patriotism and duty, have joined the colors are not only risking their lives, but are cheerfully sacrificing their careers, and in many instances their financial interests, to protect the honor of the nation. It, therefore, becomes the duty of those of us who, for various reasons, are unable to enlist, to do something more than our share in keeping the machinery of industry moving.

Other wars have been fought only on land and sea, but in this conflict the combatant areas have been greatly extended by the advent of submarines, flying machines, and even subterranean warfare. In previous wars the armies and navies of belligerents were practically the only forces engaged; in this war the full economic strength of nations is drawn into the contest and every branch of scientific and industrial effort is taxed to the utmost.

Intensifying production and conserving the supply of food and clothing constitute service within the reach of all, but the engineers, electricians and chemists of this country can go a step further and utilize their technical training to develop such new devices and improvements, equipment and methods as will give our Army and Navy that superiority which will assure victory.

Inventive talent in this country is by no means confined to the membership of our societies; members who have employees or acquaintances of an originative turn of mind should make an effort to stimulate that most useful talent by passing on to such persons the bulletins as they are received, and also by calling attention to the numerous ably written articles on the mechanical phases of the war, published in technical and popular magazines.

In the world conflict which is going on today, the three dominating factors—the submarine, the automatic machine gun, and the flying machine—are all American inventions. This nation is still in its youth and can therefore be expected to do in future still greater things than it has done in the past. War is a new occupation to us, but under the stimulus and pressure of its necessity, we should advance as far in the arts of war during the next two years as we normally would in twenty.

Some of the civilian engineers of this country are now rendering great service to the Government, through the agencies of the Council of National Defense, the Naval Consulting Board, the National Research Council and their numerous auxiliary committees, but unfortunately only a small proportion of the technical men of this country are so situated that they can go to Washington and engage in this service; therefore, some means of utilizing the patriotism and originative thought of our members had to be devised.

For this purpose the War Committee of Technical Societies has been organized, and it hopes to give the members of the Technical Societies who are obliged to stay at home, an opportunity to use their inventive talent and techincal training in the study of the varied problems which arise in the preparation for and prosecution of the war—thus making valuable contributions to the national cause.

The greatest care will be taken to discover and utilize everything of value that may inhere in suggestions and inventions submitted. Not only will they receive studious examination, but, when necessary, trials and experiments will be conducted. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular department of the Army and Navy Service, where they may be most profitably utilized.

D. W. BRUNTON, Chairman,
War Committee of Technical Societies.

NEW YORK, October, 1918.

SHOP PROBLEMS

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE

ASSOCIATE EDITORS: JESSE L. JONES, **Metallurgical** PETER W. BLAIR, **Mechanical** CHARLES H. PROCTOR, **Plating-Chemical**

ANNEALING

Q.—We should appreciate being furnished with the chemical formula giving ingredients of composition of liquid used in annealing brass or copper in lieu of annealing by application.

A.—In the annealing of copper and brass it is necessary that the articles be entirely protected from atmospheric conditions, if the formation of scale is to be avoided. The removal of scale necessitates pickling. Various furnaces have been devised for bright annealing such products. By our plan the articles, such as copper wire or strip, are drawn into closed muffles or retorts through water seals. They are then heated to redness here and after annealing pass out through similar water seals.

Annealing in a bath of a molten salt or mixture of salts has certain attractive features, but a multitude of drawbacks. Some of the salts that could be used, such as potassium or sodium cyanide, are either unobtainable or very expensive. The same thing is true of potassium or sodium nitrate which are devoted to making munitions. Barium chloride has been used for annealing high nickel content resistance wires, but its melting point is above that of brass and almost equal to that of copper.

If graphite crucibles are used for melting the salts they are rapidly attacked at high temperatures, the sand of the crucibles being dissolved by reacting with any sodium salts present and fumes are given off that are far from pleasant. If you wish to experiment you might try a mixture of sodium hydrate (caustic soda) and calcium chloride (chloride of lime). The proportions can be adjusted to give the melting point desired. The articles after annealing are removed from the molten salts and quickly cooled in water to avoid oxidation.—J. L. J. Problem 2,625.

CASTING

Q.—We have a small brass rolling mill and are having a lot of trouble with our discs, having what they call pipes. We are making a disc 6 inches in diameter and 3/8 inch thick. These pipes sometimes go into the discs about an inch. Can you tell us what causes them, and also how to overcome them?

A.—The most likely cause of pipes or spills, which we guess that are in your metal, is oxide. If dirty scrap is used, or even with new stock, if the metal is allowed to remain exposed in the fire for a considerable time this oxide or dross is formed and then it is contained in the metal, so that when the bars are rolled these spills or pipes show up.

You can judge fairly well whether the defects that you find in your metal are actually due to this cause by noting whether the inner surfaces of the pipes are clean or dirty. On examining a pipe with a glass you probably will see some greyish matter, which is oxide.

If, however, the surface is clean, then the chances are that the defects are caused by cold metal, which did not flow smoothly and did not fill up evenly in the mold.

Another cause of pipes is that of using an oil on the molds that does not have body enough to hold up under the heat of pouring. The oil should contain enough hydro-carbon so that sufficient reducing atmosphere is caused to reduce the oxide of spelter that is formed on the outside of the stream while the metal is being poured. Lard and fish oil being so expensive at the present time, it is advisable to use a heavy cylinder oil on the molds, and this will have body enough to withstand the pouring process.

We have heard of a number of concerns attempting to use a thin oil on their molds, and they have had just the trouble that you describe.

If you discover that your oil is all right and trace the trouble to the casting shop, we would advise you to cut down on the amount of scrap used, or use a little chloride of zinc flux on the top of the pot of metal before it is poured, in order to eliminate as much of the dross as possible, but the better way is to improve the quality of the mixture.—K. Problem 2,626.

GILDING

Q.—How is the fire gilt produced on buttons used on naval officers' uniforms?

A.—Fire gilding is also termed mercury gilding and is one of the oldest methods in existence for plating articles of copper, brass or bronze with pure gold. Briefly mentioned the method is as follows: The articles are cleaned with the regular acid dips after first removing the oils or grease with the usual hot alkaline cleaning solutions. After thoroughly washing the articles immerse them in undiluted nitric acid, which is the firing off dip, then immerse in a bright acid dip prepared as follows:

Nitric acid	½ gallon
Sulphuric acid 66%	½ gallon
Muriatic acid	½ ounce
Water	1 pint

After bright dipping and washing, the articles should be given a film of mercury by immersing in a dilute solution of nitrate of mercury, which is prepared by dissolving 1 part of metallic mercury in 1⅛ parts of nitric acid, using a gentle heat for dissolving the mercury. Then to this nitrate of mercury add 25 parts of water. If the color of the mercury deposit is cloudy run the articles through a cyanide dip, consisting of the following:

Cyanide of sodium	4 ounces
Water	1 gallon

Rewash the articles in water and drain thoroughly.

The gold amalgam is now applied and can be done by tumbling the articles in the amalgam and at the same time adding small proportions of nitrate of mercury to just keep the articles moist. The amalgam is made up from 8 parts by weight of metallic mercury to 1 part of 24 karat gold in the form of fine ribbon gold. Heat the mercury to a cherry red in an iron pot, then add the gold, stir thoroughly with an iron rod and when the gold is all dissolved pour the molten mixture into a porcelain dish filled three-fourths with water. When the mixture is cool work the mixture with the hands as you would do in mixing bread. Tilt the dish slightly so that the excess of mercury that is worked out with the fingers will run off into another dish kept in reserve for the purpose. When the mixture becomes plastic like putty put into a chamois leather bag, fastened so that the mixture will not run out and squeeze all the mercury you can from the mixture.

The remaining mass will be the gold amalgam, consisting of approximately 33 parts of mercury and 57 parts of gold in 100 parts of the amalgam. The mercury should be used over again as it may contain some gold.

After applying the amalgam as stated the articles are ready for the firing process. A small gas or coke furnace should be arranged for the firing process and should be completely enclosed so that the fumes from the mercury do not escape outside of the furnace, except through an iron pipe leading into cold water. At the end of the pipe cloth should be fastened and should pass down into the water as the vapor upon cooling in the water from the evaporated mercury is converted into metallic mercury and may be used over again.

The best method for firing is to prepare a cylinder made up from iron wire mesh with a door and so supported that the cylinder can be revolved over the fire. A more even evaporation results than when placed upon pans and also saves time. The articles must be heated to 650 degrees Fahr. to produce complete evaporation of the mercury and as soon as the greenish yellow tone is produced the articles should be removed from the fire and when cool scratch brushed to bring out the color, which will be found to be a trifle pale.

After brushing the articles they are re-gilded by simple

immersion or by the salt water method. The gilding solution should be prepared as follows:

Water	1 gallon
Sodium ferro-cyanide	3¼ ounces
Sodium cyanide	½ ounce
Soda Ash 58%	4½ ounces
Sodium phosphate	2½ ounces
Sodium sulphite	¾ ounce
Gold Trisalyt (40% fine gold)	72 grams or 3 dwts.

Prepare in an enameled kettle and heat to 160 to 180 degrees Fahr. and add the gold Trisalyts when all other salts have been dissolved.

Iron wire mesh baskets should be used for immersing the scratch brushed buttons in the above solution. After washing and drying they are then ready for burnishing which completes the process.

It has been customary to prepare the above type of gold dips in cast iron steam jacketed kettles. An improvement which saves the gold is to place a thin sheet of steel in the gold dip when operating and which may be removed when the solution is not in use. —C. H. P. Problem 2,627.

MIXING

Q.—Can you furnish us with a suitable mixture for the making of tuyeres such as used in blast furnaces? We understand that this is a cored casting that has to stand a hydraulic pressure of approximately 600 pounds. The casting is subject to a considerable amount of heat while in use.

A.—It is common practice among the majority of the makers of blast furnace tuyeres to use an ordinary grade of casting copper and add a small amount of phosphor tin to it to give sound castings. Others use small additions of zinc or lead. All of these things are undesirable as they lower the melting point of the tuyere casting, lower its heat conductivity and hence its efficiency in the blast furnace.

Absolutely pure copper with no additions whatever would be the ideal material for these articles if solid sand castings could be made from it. This is possible but it cannot be done commercially and hence the use of a deoxidizer becomes necessary. The best deoxidizer is 10 per cent. silicon copper. Use the best grade of electrolytic ingot copper (wire bar grade) and add about 6 ounces of silicon copper to each 100 pounds of the copper or the minimum amount that can be used.

Get the copper boiling, add the silicon copper outside the furnace and pour an open sand test piece about 1½ inches in diameter by 3 inches long before pouring the castings. If the test piece comes up add a little more silicon copper and pour another test piece. When the test piece shows a good shrinkage pour the castings.—J. L. J. Problem 2,628.

PLATING

Q.—Can you give us a formula or a method of plating brass steam gauge dials? At the present time we are using a combination of chloride of silver and salt, which is rubbed on the dial. This, however, is a very slow process. We have tried nickel plating the dials, but this gives a glossy finish, and is not satisfactory. We want a dull white finish on the dials.

A.—A tin deposit gives a uniform white coating for dials, especially if brushed down after plating with a soft tampico brush, using FFF pumice stone to scour the surface. The tin solution should be prepared as follows:

Water	1 gallon
Sodium cyanide	1 ounce
Tin chloride	2 ounces
Rochelle salts	2 ounces
Caustic salts	½ ounce

Do not use a voltage in excess of 1 volt, and the solution will give the best results at a temperature of 120 degrees Fahr. Pure tin anodes should be used.

The most satisfactory method for silvering steam gauge dials would be to silver plate them in a regular electro-plating solution for a short time. The dead or matt finish should afterwards be produced by the aid of a low pressure sand blast, using finely powdered glass or powdered silica as the abrasive. An improvement of your present method might be obtained by using the following combination:

Freshly precipitated silver chloride	1 ounce
Cream of tartar	25 ounces
Common salt	25 ounces
Precipitated chalk	25 ounces

Mix the compound thoroughly and use a little at a time as required and distilled water should be used in preference to ordinary water in preparing the paste.—C. H. P. Problem 2,629.

SOLDERING

Q.—Will you kindly give us a formula for soldering 10K and 14K gold which is enameled? It must be fairly hard as we solder top pieces on gold shanks and then enamel them, and our trouble is that our solder is too soft and it flows when it is heated in the enamel furnace and then the holes have to be filled up, which spoils the enamel.

A.—For articles which are to be enameled only solders composed of gold and silver or gold, silver and copper can be used. These are sometimes called "enamel solders." A very refractory solder of this kind is composed of gold 74 parts and silver 18 parts. A more fusible solder consists of gold (750 fineness) 32 parts, silver 9 parts and copper 3 parts. It is desirable to have your solder approach as nearly as possible to the melting point of the article enameled both on account of the color and more especially because your enamel is evidently of rather high fusibility. It is suggested that you ascertain the melting points of the alloy you are using, the solder and the enamel. As pyrometers are rather expensive you may prefer to use the well known Seger cones, that are used for controlling pottery firing. With the data thus obtained you could adjust the composition of your enamel and solder so that there would be enough difference in their melting points to avoid any trouble such as you describe.—J. L. J. Problem 2,630.

TESTING

Q.—Please give me the formula for acids to use for touchstone for testing gold. I have testing needles and a black stone, but using nitric acid, I do not get definite results as 12K seems to test to the same grade as 14K and 16K to the same as anything above it.

A.—The "touchstone" is said to be a species of black basalt obtained chiefly from Silesia and its fitness for testing gold is due to its presenting a dark, smooth ground, adapted for exhibiting shades of color and the fact that it is not affected by nitric acid.

The use of any other acid or mixture of acids instead of nitric acid would not render your test more reliable, as all that the acid is supposed to do is to dissolve out the copper or silver in the streak.

It is suggested that you attempt to secure a better test by mounting your testing needle in a holder, putting a disc on top of the needle, carrying a definite weight and drawing the touchstone under the needle. Each streak would then be made by a uniform weight and in this way the indications should be sharper and more easily recognized.—J. L. J. Problem 2,631.

WELDING

Q.—We have an order for welding manganese bronze in rods 24 inches long by 1 inch in diameter. Would you please send us the composition for such a material?

A.—A formula for welding manganese bronze would be the same as a formula for forging manganese bronze, and should consist substantially as follows:

Copper	58 to 60 parts
Tin	½ to 1 part
Iron	½ to 1 part
Manganese	Trace
Balance, spelter.	

A good grade of spelter, however, must be used to get satisfactory results as to high tensile and elongation.—K. Problem 2,632.

PATENTS

A REVIEW OF CURRENT PATENTS OF INTEREST

The age of these patent notices is due to the delay in the issuing of patent reports.—Ed.

1,272,917. July 16, 1918. **Removing Enamel from Enameled Metal Surfaces.** Raymond D. Cooke, of Terre Haute, Ind., assignor to Columbian Enameling & Stamping Company, of Terre Haute, Ind., a corporation of Indiana.

In the practice of the art of enameling metals there is always a certain amount of loss due to mechanical injury to the enamel or to other causes which render an article unfit for profitable disposal on the market. It is, therefore, highly desirable that a process be found which will remove vitreous enamel cheaply and without undue action on the metal, leaving the metal article in a condition for subsequent enameling or for any other purpose to which it may be desired to put it.

This invention consists essentially in treating the article first with an acid solution which causes the enamel to become porous, and which is followed by a short immersion in an alkaline bath which loosens and softens the enamel to such an extent that it falls off or may be brushed off.

In the preferred process there is used an acid bath of 10 per cent hydrochloric acid maintained at a temperature of about 160 degrees Fahr., by any suitable means, in which the enameled article is allowed to remain about fifteen minutes. After removing from this bath the article is washed in water and placed in a 25 per cent solution of sodium hydroxid, heated to about 160 degrees Fahr. until the enamel has been dissolved, which may be 10 or 15 minutes. The article is then washed and dried.

1,273,146. July 23, 1918. **Aluminum Solder.** David M. Campbell, of Brooklyn, N. Y.

The object of the invention is to provide an alloy in the shape of a bar which will solder aluminum articles by a soldering iron or braze them by means of a torch.

The solder alloy is formed of copper, aluminum, lead, tin and zinc. The lead and aluminum are melted first, for they will withstand heat without burning. To this bath the tin is added, and when it is melted the zinc is added, and then the copper, which copper must be soft and refined. The entire bath is thoroughly mixed and then molded into bars as soon as possible without letting the molten bath stand over the fire, for it has a tendency to burn out and lose in strength.

To make the soft solder alloy the proportions by weight are as follows:

Copper	4	parts or	7.14%
Aluminum	4	" "	7.14%
Lead	8	" "	14.30%
Tin	16	" "	28.60%
Zinc	24	" "	42.82%

In the hard solder the proportions by weight as as follows:

Copper	16	parts or	6.87%
Aluminum	24	" "	10.30%
Lead	30	" "	12.88%
Tin	48	" "	20.60%
Zinc	115	" "	49.35%

1,273,706. July 23, 1918. **Process of Annealing Aluminum.** Laurence H. Whitney, of Pittsfield, Mass., assignor to General Electric Company, a corporation of New York.

The present invention relates to the annealing of aluminum after the metal has been rendered hard by mechanical working, and the object of the invention is to produce aluminum articles in which the unavoidable silicon impurity is substantially all in the dissolved state instead of being present as graphitoidal silicon.

In carrying out the invention, the metal is cast as usual into any shape suitable for subsequent mechanical treatment, such as drawing, spinning, stamping, forging or the like. During the desired mechanical treatment which is carried out as usual, the metal unavoidably becomes hardened. Thereupon the shaped or worked articles are placed in a furnace which may be heated and cooled quickly, for example, an electric muffle furnace, and heated rapidly to a temperature in excess of 370 degrees C., and preferably below 450 degrees C. The annealing treatment is continued for about 2½ to 3 hours. The aluminum articles then are removed from the furnace and are quickly cooled, for example, if the articles are large, by blowing air upon them or by quenching them in water. Smaller articles may be sufficiently rapidly cooled by merely exposing to the air.

1,273,877. July 30, 1918. **Alloy.** Paul Richard Kuehnrich, Sheffield, England.

The object of this invention is to provide an improved alloy possessing the qualities and endurance almost exclusively associated heretofore with high speed tool steel. An alloy according to the present invention comprises a base of nickel, chromium and silicon, to which a substantial quantity of aluminum has been added. It is to the presence of this aluminum in the alloy that its peculiar properties are due, enabling it to be used as a substitute for high speed steel. The hardness of the alloy is determined by the amount of aluminum, but when excessive quantities of the latter are added the alloy becomes too brittle for use for high speed tools. The nickel may be partially replaced by cobalt.

The following mixture has been found in practice to give excellent results:

Ferro-chrome (containing about 70% chromium and 4% to 6% carbon)	8 lbs.
Nickel	21 lbs.
Silicon	1 lb. 11 ozs.
Aluminum	2 lbs. 8 ozs.

1,274,995. August 6, 1918. **Process of Platinumizing Metal Surfaces.** Benjamin B. Crombie, Port Chester, N. Y.

This invention relates to improvements in means and processes used in depositing a permanent coating of platinum upon the surface of another metal.

The principal object of this invention is to provide a process for plating metals with platinum by the use of chemical and mechanical means only.

A further object is to provide a platinumizing means applicable broadly to any metal, which is easily and quickly applied and of the utmost durability, the coating becoming a component part of the metal surface covered by it, indivisible and inseparable, irrespective of its thickness, which depends upon the quantity of composition used.

The plating composition consists of a normal platinum chloride solution ($PtCl_4$) ten parts and a normal ammonium chloride solution (NH_4Cl) eighteen parts forming ammonio platinio chlorid ((NH_4) $(2PtCl_6)$) which is precipitated as a yellow powder.

To one part by weight of the ammonio platinio chlorid add eight parts by weight, of potassium bi-tartrate ($KHC_4H_4O_6$), and three parts by weight of distilled water.

This composition is applied to the polished surface of the metal article to be plated by a chamois leather dipped in the paste and rubbed vigorously upon the metal surface, the operation being continued or repeated until a desired thickness has been secured.

1,277,035. August 27, 1918. **Method of Producing Metals.** John J. Boericke, Nurim, Pa.

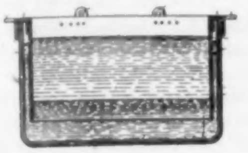
This invention relates to the reduction of metals, particularly rarer metals, such for example, as vanadium, chromium, manganese, and the like, by what is known as the aluminothermic process, wherein metallic aluminum, a mixture of aluminum or an alloy of aluminum, or other material having an affinity for oxygen, is used as the reducing agent. The primary object of the invention is the provision of an improved method whereby the rarer metals can be produced very economically and the comparative yield of and the

quality of the finished product greatly increased and improved.

The patent covers: The herein described process of producing metals or alloys from metallic compounds which consists in preheating the compound, in mixing ingot aluminum with the compound, and then in instituting an exothermic reaction.

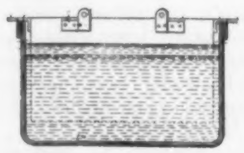
1,275,196. August 13, 1918. **Zinc-Melting Apparatus.** Takekichi Aramaki, of Kiu-Gum, Tukuoka-Ken, Japan.

This invention relates to an apparatus for melting zinc, particularly to such apparatus in which into a main tank a bottomless internal jacket is suspended leaving a space between tank and jacket.



It is the object of the present invention to provide an apparatus adapted for continuous operation allowing an exchange of the inner jacket without disturbance of the operation.

Another object of the invention is to be seen in the arrangement of show holes through which the operation may be observed at all times.

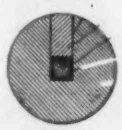


The patent covers: In zinc melting apparatus, as shown in cut, an outer tank formed with comparatively acute corners, an inner jacket provided with flange members adapted to be positioned within said tank and to be supported thereby by means of said flange members engaging the upper edges of said tank, said jacket being constructed shorter, smaller, and with more rounded corners than the tank whereby a space is provided between the bottom and sides of the tank and jacket, the difference in their corners resulting in a widened space at these points, and covers adapted to close intervening spaces between the tank and jacket between the flange members.

1,275,449. August 13, 1918. **Metal Package.** Herbert L. Lemon, Chicago, Illinois.

In this type of metal packages the package is cored and a quantity of unmelted fluxing material is placed in the core and is confined therein by pouring in or plugging the aperture with other Babbitt-metal or other suitable material.

In the use of metal packages of this type it has been found that the fluxing material, covered and inclosed within the metal ingot as described in the patent, is subject at times to the absorption of moisture.



The object of the present invention is to overcome the defects above noted and to provide a metal package having a core of fluxing material which will be moisture-proof, and will therefore fill the requirements, and will result in an even and uniform consistency of metal when the package is melted.

In order to prevent the absorption of moisture by the body of fluxing material, this body, as shown in cut, is covered or coated with a thin layer of moisture-proof fusible material, such, for instance, as paraffin or gelatin. These two substances are mentioned merely as illustrative of material suitable to this purpose, but any material which is fusible and moisture-proof may be employed. By coating the fluxing material with such a substance it has been found that the absorption of moisture by that material is avoided, thereby overcoming the defects of the prior package.

1,276,916. August 27, 1918. **Metallic Alloy.** Frank S. Hodson, Philadelphia, Pa.

This invention consists of an improved metallic alloy. One object of the invention is to provide an improved metallic alloy of high tensile strength and hardness and which is particularly suitable for use in the manufacture of high tensile strength die castings, drawn rods and bars, and sheets, etc.

According to the invention, the improved metallic alloy is composed of zinc, aluminum and copper.

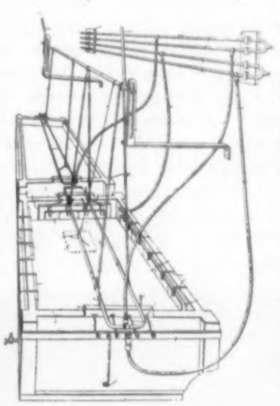
In carrying out the invention, the quantities of the metals forming the improved alloy may vary preferably in the following relative proportions:

Zinc	80% to 85%
Aluminum	18% to 14%

the remaining percentage being completed with copper.

1,276,600. August 20, 1918. **Electrical Etching Apparatus.** Joseph H. Weeks, of Rutledge, Pennsylvania, assignor to Jackson S. Weeks, of Delaware County, Pennsylvania, and Raymond M. Weeks, of Philadelphia, Pennsylvania, trustees.

This invention relates to electrical etching and has for its object the improvement of the apparatus used in that art in the following particulars.

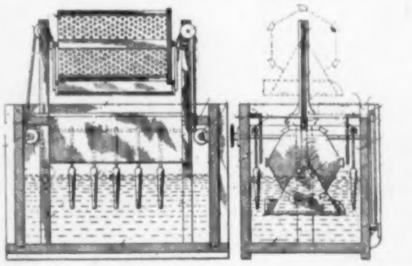


The anode or anodes are given an intermittent or periodic motion in the electrolyte by mechanical means automatically controlled. The cathodes are so located and spaced with respect to the anodes as to produce sharp and clean effects. Means are provided in the form of brushes which automatically keep the cathodes clean. Anode and cathode circuit connections are made very simple, but perfectly balanced to secure equalized distribution of the current.

The patent covers: An apparatus, shown in cut, for electrical etching comprising in combination, a tank or bath to contain an electrolyte; an anode support arranged to hold a plate to be etched suspended in the tank and in the electrolyte contained therein, cathodes surrounding and underlying a plate suspended in the electrolyte, a bus-bar for said cathodes, a plurality of separate current leads extending between different points on the anode support and a source of current and a plurality of separate current leads extending between different points on said cathode bus bar and the same source of current.

1,276,649. August 20, 1918. **Electro-plating Apparatus.** F. H. Hartzell, Dayton, Ohio, assignor to Wayne C. Dunston, receiver of Crown Hardware Manufacturing Company.

This invention relates to electroplating apparatus and is an amplification and continuation of the invention disclosed in the co-pending application, Serial No. 68472, filed December 24, 1915.



The present invention relates primarily to the construction of the vat or tank and to means for facilitating the discharge of the contents of the cylinder or drum.

The object of the invention is to simplify the structure as well as the means and mode of operation of such devices whereby they will not only be cheapened in construction, but will be more efficient in use, convenient in operation, economical, and unlikely to get out of repair.

A further object of the invention is to provide improved hoisting apparatus, as shown in cut, for elevating the drum or cylinder from the tank and lowering it thereinto.

A further object of the invention is to provide improved means for recovering from the tank parts or articles accidentally lost from the cylinder or drum and to provide improved means for discharging the contents of the drum or cylinder.

EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST

NEW USES FOR ZINC

With an enormous strain on the supply of non-ferrous metals to meet present requirements, especially tin-plate and aluminum, zinc is now assuming even greater importance in the industrial world than ever before. Experiments have recently brought to light that rolled zinc particularly embodies qualities that foretell its constantly increasing use both at present and after the war.

Manufacturers for some time have been urged as a pattriotic necessity to use metals other than tin-plate and aluminum in the production of certain commodities. As a result, a "Make it of zinc" slogan was adopted. That this has become a fixed habit with numerous metal manufacturers is seen from a new list of zinc products which the New Jersey Zinc Company has compiled. Such things as pencil tips, shaving soap containers, trouser buttons, bottle covers, boxes and linings, addressing plates, stencils and scores of others are the outgrowth of this campaign. The new practice has brought the aid asked by the government in conserving tinned iron and in supplying material to industries which were almost out of tin and aluminum by the falling off of imports due to abnormal shipping conditions.

NEW JERSEY ZINC CO.'S EXHIBIT AT EXPOSITION OF CHEMICAL INDUSTRIES, NEW YORK, SEPT. 23 TO 28, 1918.

"Zinc is just coming into its own," said E. V. Peters, assistant general sales manager of the New Jersey Zinc Company, last night. "Research laboratories have found that this metal embodies the essential qualities of good material for metal products of the non-ferrous class. The response to the government's wish for such a replacement metal has brought to light convincing evidence of the wide scope of zinc's usefulness.

"Probably few people realize the manifold uses to which zinc products are put. For instance, it is not generally known that zinc oxide forms a considerable per cent of the composition in an automobile or truck tire; this product giving tires and other high grade rubber goods resiliency and durability.

"Zinc oxide also gives wearing quality to paint. This material, when used in paints with a corresponding mixture of white lead sulphate, which the zinc company encourages, provides toughness, lustre and color constancy to paint, qualities that are essential in this age of conservation.

"Spelter or metallic zinc, made from the uniquely pure Franklin, New Jersey, ore is with copper a component in the manufacture of high grade brass. It galvanizes telephone and telegraph wires to keep them from rusting and becoming brittle and has a large field of usefulness in other ways.

"Rolled zinc has demonstrated that it can be easily drawn and spun; that the high grade quality, such as that produced from Horse Head spelter is not brittle, and that it takes as high a polish as may be desired.

"Among other points favoring zinc may be mentioned the fact that, after the war, America will be looked to to supply several countries of the old world now in the throes of the great struggle. They must be rebuilt and it will require a long time before their own resources, such as re-establishment of manufacturing plants and the procurement of materials, can be made ready to turn the wheels again. Much zinc will, therefore, be required from this side to aid in the rebuilding program.

"Our zinc fields are both accessible and almost inexhaustible. Our facilities which were increased soon after the requirements of the allied countries became apparent at the beginning of the war, are ample to meet the expected demands. In the reconstruction period zinc roofing, being non-corrosive, will be needed in large quantities.

"These conditions will apply to America as well as to Europe, where zinc, as a roofing material, has been much used in the past. In fact the non-rusting property of zinc is a quality already attracting to this metal much favorable attention on the part of manufacturers. Weather strips made out of zinc have been used in all climates for years and this metal has proved very suitable for such products.

"For use in building hardware, zinc has, likewise, demonstrated its practicability. This applies to door knobs, door castings, window sash and fixtures, opening an entirely new field for the consumption of the metal. Such uses promise to increase when building activities are again renewed on an extensive scale.

"Zinc is the logical material for making leaders and gutters due to its ability to withstand outdoor wear, while in such commodities as electric fuses, this material is standard. Sulphuric acid, an important ingredient in fertilizers, is produced from sulphur found in western zinc ores. This material will grow in importance after the war due to increased crop production in various parts of the world.

"Zinc dust, another product, is in extensive demand for use by the dyeing industry. Among its other uses are recovery of gold and silver by the cyanide process and as a material in non-corrosive marine paint."

METALLIC PHOSPHORO

The New Era Manufacturing Company, Kalamazoo, Mich., furnish the following information relating to their Metallic Phosphoro, which is offered as a practical substitute for tin in brass and bronze mixtures.

In brass formulas specifying tin, from one-half (½) to the whole amount specified may be substituted with Metallic Phosphoro, as illustrated by the following examples:

First. If a brass formula specifies five (5) pounds of tin, use two and one-half (2½) pounds of tin, and one (1) pound of Metallic Phosphoro, and add one and one-half (1½) pounds of zinc to the amount specified in the formula.

Second. If a brass formula specifies two (2) pounds or less of tin, substitute the whole amount with Metallic Phosphoro, adding zinc to balance the difference between the amount of tin specified and the amount of Metallic Phosphoro used.

In plain tin bronze, one-quarter (¼) of the tin specified may be substituted with Metallic Phosphoro. In phosphor bronze the best practice is to substitute one-quarter (¼) of the tin and one-half (½) of the phosphor tin or phosphor copper with Metallic Phosphoro; but a good dependable quality of the bronze may be produced by using the full amount of tin specified

and substituting all of the phosphor tin or phosphor copper with Metallic Phosphoro, as illustrated by the following examples:

First. If a bronze formula specifies twenty (20) pounds of tin, use fifteen (15) pounds of tin, two (2) pounds Metallic Phosphoro, and add three (3) pounds of copper to the amount specified in the formula.

Second. If a phosphor bronze formula specifies ten (10) pounds of tin and five (5) pounds of phosphor tin, use seven and one-half (7½) pounds of tin, two and one-half (2½) pounds of phosphor tin, two (2) pounds of Metallic Phosphoro, and add three (3) pounds of copper to the amount specified in the formula. Or a very satisfactory quality of bronze would be secured by using ten (10) pounds of tin, no phosphor tin, two (2) pounds of Metallic Phosphoro, and adding three (3) pounds of copper to the amount specified in the formula.

In the proportions above mentioned, Metallic Phosphoro may be substituted for tin in all brass and bronze mixtures without prejudice to the quality of castings. The ratio of substitution to always be one (1) pound of Metallic Phosphoro in the place of two and one-half (2½) pounds of tin.

The best results are obtained by melting the copper under a layer of pulverized charcoal, the tin and Metallic Phosphoro to be melted together in a separate container and poured into the molten copper, the mixture to be thoroughly stirred, and skimmed just before pouring.

THE DEISTER CONCENTRATOR

The machine shown in the accompanying photograph is known as the Deister-Overstrom diagonal deck foundry residue table and is particularly recommended by the manufacturers, the Deister Concentrator Company of Ft. Wayne, Ind., to manufacturers who wish to pay particular attention to the recovery of metal from foundry waste. It is stated by the manufacturers that although the question of recovery of metal from foundry residues has been paid considerable attention for a good many years, it was only after the introduction of this table that a high recovery of the values in the residues, both coarse and fine, could be made.

Special attention is called by the manufacturers of the construction of this residue table. The main base and tilting frame are both composed of structural steel firmly riveted or bolted together, while the movable parts are fitted to produce the least possible friction and so facilitate the adjustment of the table to its work. The deck is built of the very best grade of cypress wood and is covered with the highest quality of linoleum that can be obtained.

Great simplicity is claimed by the manufacturers for the operation of this machine and it is stated that even the most inexperienced laborer, after a few days in which to learn the principle underlying the work of the concentrating table, can produce results equal to the best. With a steady even feed, very little attention is required and the saving to be made by the use of such tables, it is claimed, will pay for the installation many times over.

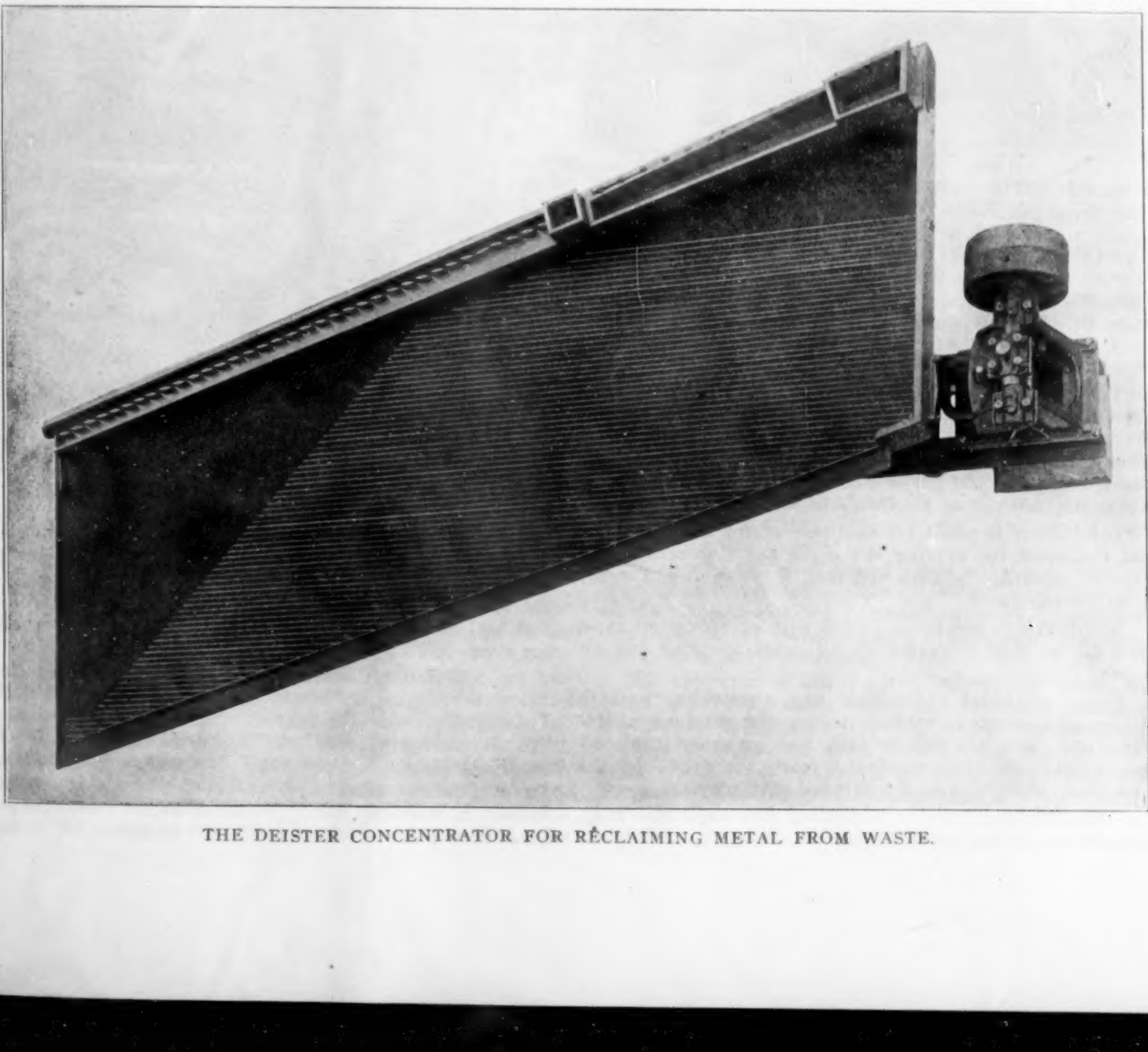
These tables are built in two sizes, one known as the laboratory size with the capacity of one-third of a ton of refuse passing through per hour and a larger type with a capacity of three-fourths to a ton per hour. The laboratory size of this table was exhibited at the Milwaukee, Wis., Foundrymen's Convention, October 7 to 11, 1918.

DINGS MAGNETIC SEPARATOR

The machine shown in the cut is known as the Type M magnetic separator and is manufactured by the Dings Magnetic Separator Company, Milwaukee, Wis., and was shown at the Milwaukee exhibition.

This magnetic separator, known as the disk type, is especially recommended for use in brass foundries and metal refining works. The continued increasing demand for these machines justifies the claim that it is the best magnetic separator on the market for removing iron from brass and copper turnings, borings, punchings, washings, skimmings, fine scrap, etc., and with a new form of magnets and new conveyor supports, it is now better than ever.

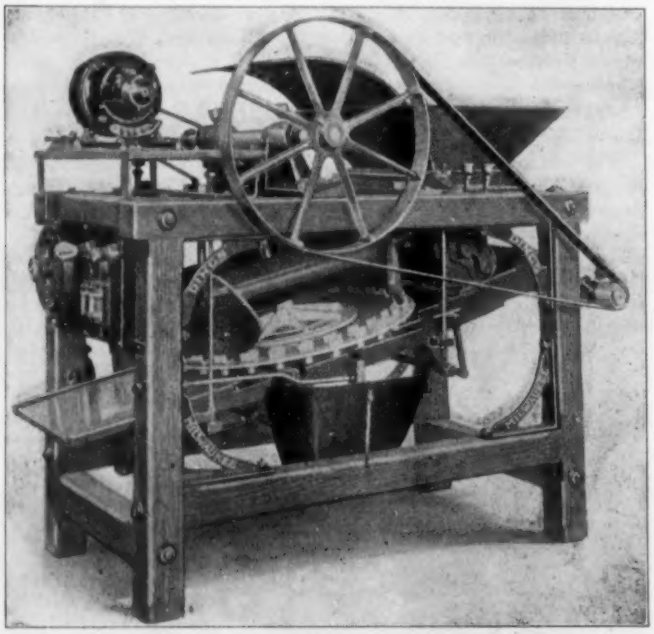
The magnets consist of a large stationary primary magnet



THE DEISTER CONCENTRATOR FOR RECLAIMING METAL FROM WASTE.

body and a series of small secondary induced magnets mounted upon a rotating disk. The primary magnet is held solidly in a fixed position and has heavy double coils and cores with pole pieces projecting downward and conforming to the circle of the disk. The secondary magnets, which are made of the best Swedish iron, are inductively energized by the primary magnets when over the conveyor, but become demagnetized as they leave the proximity of the primary poles and automatically discharge any iron or magnetic material they may have attracted, allowing it to drop at the points on the sides where the disk overhangs the conveyor, and is conveyed by chutes into a box or receptacle on the floor beneath. The non-magnetic metal passes off at the end of the conveyor to final delivery. Special attention is called to the following important features:

(1) The stock in passing over the conveyor is brought under a powerful magnetic field at two different points, which is equal to two separate treatments with an ordinary separator.



DINGS' MAGNETIC SEPARATOR, TYPE M, NO. 2, WITH GENERATOR ATTACHED.

(2) As the iron is picked up without the magnets coming into direct contact with the mixed metals, but slight chance is offered for mechanical entanglement, and for this reason it makes an excellent separator for handling material containing a heavy burden of iron, or for recovering brass from iron turnings.

(3) The electricity is conducted directly to stationary magnet coils and the secondary magnets discharge the iron and magnetic material automatically. There is no commutator, circuit breaker, cut-out device, or sliding electrical contacts to spark, flash and cause trouble, and no expensive revolving brush, scraper or knock-off to wear out.

(4) The hopper is provided with two shafts, one for feeding and the other for stirring the stock and preventing any stoppage or choking up, thus the feed is positive and even, and is easily regulated.

(5) The bearings are all provided with compression cups for hard oil, so that there are no oil holes to catch dirt or metal dust.

(6) Every electrical connection and mechanical part is accessible for inspection without taking the machine apart. The electrical parts are substantially and carefully insulated and protected, and with reasonable care there can be no question about durability and continued efficiency.

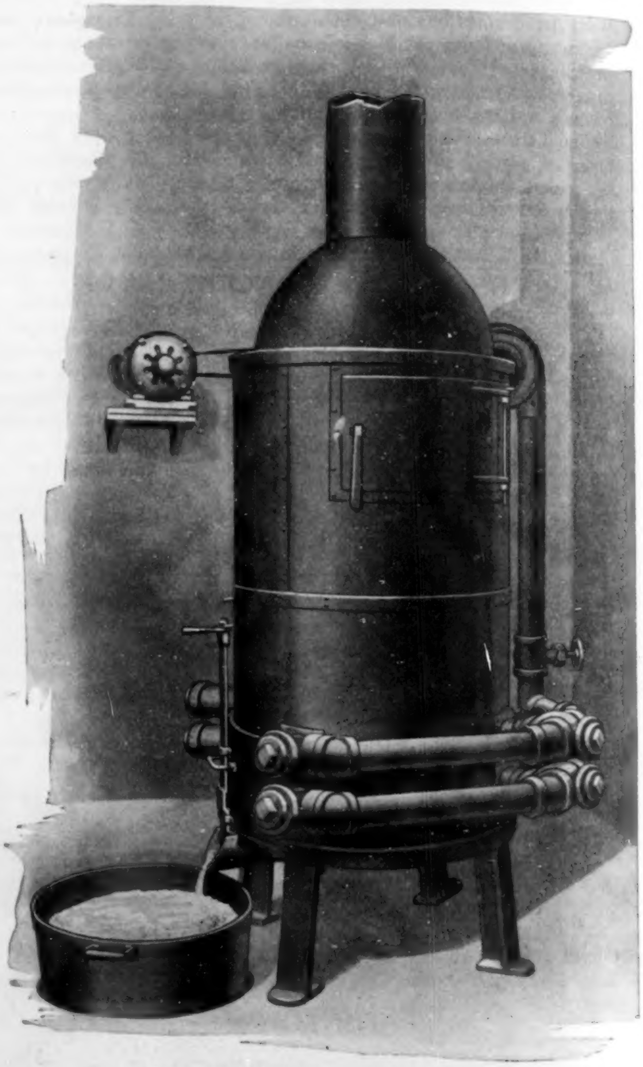
More complete information regarding this separator may be obtained by asking for bulletin No. 33.

THE CORNWALL DROSS CONVERTER

Mason, Davis & Company, Grand Crossing, Chicago, Ill., have issued an interesting boooklet containing some pertinent facts relating to the Cornwall process for the treatment of white metal oxides and drosses and the converter which is used in carrying out the process.

The company states that the Cornwall process enables the metal worker to recover in one operation, by using the apparatus shown in the cut, all the metallic contents of white metal oxides, skimmings, wipings, scruff metals, etc., from tin, babbitt, solder, type metals, lead and their alloys. This process, which is both chemical and mechanical, is said to be in successful operation in some of the largest plants in the country.

It is stated by the company that the blast principle as applied



THE CORNWALL CONVERTER.

to the Cornwall converter, as this blast furnace is called, regulates the heat at different levels, giving zones of varying temperatures so that the process is always under perfect control of the operator.

Actual recoveries obtained by the use of this Cornwall process are given below.

Material Treated	Metallic Contents Shown by Analysis	Recovery
Tin Scruff	92.06	91.80
Tin Skimmings	84.42	83.75
Solder Wipings	98.52	98.48
Solder Dross	89.12	88.60
Babbitt Skimmings	94.70	94.05
Lead Oxides	85.40	84.60

ASSOCIATIONS AND SOCIETIES

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

America had another answer to fling back at Germany during the week of September 23, 1918. This time the answer came from the chemists of the United States and was delivered in the form of the Fourth National Exposition of Chemical Industries at Grand Central Palace in New York, which, literally interpreted, declared that America has within the short period of several years freed itself from the predominance of German chemistry. The imperative war time needs of this country for chemicals that previous to 1914 we were solely dependent upon Germany for providing, have been met as a result of the activities of our own chemists and scientists. This the recent exposition at New York very strikingly demonstrated.

Practically every branch of chemistry and allied lines was represented, the exhibits covering, among dyers, dystuff manufacture, the by-products of coal and coke and iron and cement, pharmaceutical chemistry and apparatus, biological chemistry and machinery ranging from the simplest appliance to a complete plant for intricate processes; copper and other metals, aniline products, enamels, synthetic dyes and colors, corks, asphalt, lenses, foundry products, engineering apparatus, porcelains, etc.

During the last year great strides have been made in the industries based on chemistry. Among the latest achievements the country is now producing potash from several sources, and as a by-product in the manufacture of iron and cement. It has developed and improved the manufacture of light metals for airplanes, heavy metals for every purpose, dyes, soda and bleaching powder, lenses, special pottery, excessive heat-resisting utensils, etc.

The Governments of Canada and the United States were represented at the show, the Canadian Government presenting the materials it has available for development by the chemists and the financiers. The United States Government, through its Gas Offense Division, had an interesting exhibit of incendiary bombs, gas shells and gas bombs. After viewing this exhibit one had a full realization of what the chemists have accomplished in perfecting methods of offense and defense in gas warfare.

The Chemical Exposition was a growing illustration of the advantage to our industries which chemistry has afforded. The growth of our industries of all kinds has been greatly assisted by chemists. Strictly speaking, all industries are chemical industries, but some industries are more obviously chemical industries than others. This exposition had to do naturally more with the industries which are obviously chemical, but the general proposition that all industries are dependent upon chemical processes should be emphasized, even if in each case the connection is not obvious to the unthinking man. This war has taught us that all industry is more or less chemical in its character.

What the great chemical industry in this country is doing to produce the big Allied victory, what America has accomplished in taking the enormous chemical, glass and dye industries away from Germany, was demonstrated most decisively at the Exposition.

Among the exhibits which were of interest to THE METAL INDUSTRY readers were the following:

The General Chemical Company's (Philadelphia, Pa.) chief display of chemicals included commercial acids, copper sulphate, iron salts, lead acetate, tin salts, sulphate of zinc, etc.

The Rossler & Hasslacher Company's (New York) exhibit ran largely to cyanides, used for electro-plating, case hardening and heat treatment, with an enticing display of silver, copper, bronze, etc., which had been treated with cyanides. Here was apparent war-time progress as exemplified by copper, zinc and silver cyanides for plating metals; sulpho-cyanide of soda for nickel solutions and "Platin-rig" for impressing black on silver.

The Buffalo Foundry and Machinery Company (Buffalo, N. Y.) presented a heavy exhibit, loaned by the consignee in transit for exhibition purposes. Most of the machinery display was loaned by the company research laboratories, the one exception being a nitrator, shown for the first time since its completion. A. Hough, the inventor said he had conceived the nitrator to meet the demands of the Allies for picric acid. Four such machines can turn out 100,000 pounds of picric acid a day.

The Thwing Instrument Company of Philadelphia, Pa., made a strong play with their line of instruments representing indicating and recording pyrometers. These devices record all temperatures employed in the liquefication of gases.

The General Electric Company's (Schenectady, N. Y.) exhibit proved to be one of interest to practically everybody who attended the show. The lines revealed development before and during the war, indicating a wide scope of activities in the laboratories and covering improved lighting, radio apparatus, searchlights, X-ray apparatus, Coolidge tubes, water Japan, metals, alloys, chemical compounds and smoke precipitation. Special metals and alloys, special brazing and soldering and sheath wires evolved since the beginning of the war indicated progress along metal lines. New and large pliotrons; resistance tubes for radio sets; Langmuir condensation pump for pliotrons and Coolidge tube exhaust; improved electric welding; a radiator type of Coolidge X-ray tube, developed for field hospital work; resistance tubes for radio tests; electrodes for high power searchlights and numerous lighting improvements constituted the display.

The Du Pont Chemical Works' (New York and Wilmington, Del.) exhibit also offered much that was of general interest, the magnitude of its operations considered. The Harrison works, chemical works, dyestuff works, Arlington works and Fabrikoid company were embraced in the outlay. A large chart representing the basic products, always a part of Du Pont publicity plans, constituted a striking feature of the display. The meshing of Du Pont interests and the manner in which one branch fits in with another were thus brought out.

The American Pipe Bending Machine Company (Boston, Mass.) displayed "Wonder Pipe Benders," and the latest S and A types.

The Semet-Solvay and Solvay Process Company (Syracuse, N. Y.) exploited in elaborate style progression from raw materials to finished products, using charts and samples to drive home salient points. The company also featured alkali in a joint exhibit of the latter and its by-products. The finished products of the Semet-Solvay company also were displayed, the process of manufacture providing interesting stages of speculation. A war model constructed of war materials was a feature.

The Quigley Furnace Specialties Company (New York) demonstrated the company's furnace cement, "Hytempite," and a new insulating brick which is a recent offer to the heating world newly placed on the market.

Highly practical was the New Jersey Zinc Company's (New York) tribute to the week's panorama of ingenuity. Scores of the uses to which zinc is applied were presented in comprehensive form. Among the company's products are zinc oxide, spelter, zinc dust, ocher, zinc metal, zinc carbonate, and a wide variety of by-products. A feature of the exhibit revealed the many uses to which sheet zinc is being applied. Zinc coatings also play a prominent part in recent developments, metallic as well as in oxide form.

Bakelized paper and canvas made up in the form of sheets, rods, gears, tubes and similar appliances constituted the exhibit of the General Bakelite Company, New York, together with a complete line of Bakelite raw materials and products put together from such material.

The Houser-Standard Tank Company, Cincinnati, Ohio, put forth as its star exhibit round and rectangular tanks, showing methods of hooping, rodding and bracing wooden tanks in such manner as to prevent metal from coming in contact with contents of the tanks. Different types of tanks turned out by the company were illustrated by photographs.

A Swartout Entraining Separator constituted the exhibit of the Ohio Blower Company, Cleveland, Ohio. This appliance

is used for reclaiming chemicals from once used vapors.

The Brown Instrument Company, Philadelphia, Pa., offered a line of high temperature measuring instruments, pressure gauges, recording thermometers and draft gauges. A new decolescense recorder, an automatic signaling pyrometer, thermo-coupler and base metal coupler and single and multiple recording pyrometers afforded much of interest to metal manufacturing lines.

Fuel-saving apparatus, highly appropriate to the present era was the mainspring of the Precision Instrument show. This included a variety of gauges turned out by the Precision people. One of the features was an air-speed indicator of late design for use on airplanes.

Controller for automatically maintaining the liquid level in evaporators and also for discharging condensation were Taglialine Manufacturing Company headliners. Other items were indicating and recording thermometers, pressure and temperature controllers, etc.

The Anaconda Copper Mining Company demonstrated decisively that copper is king. Ore, copper matte, blister copper, anode copper and a variety of commercial bars were on show. Bars of silver and gold, the latter of little value these days, were high spots morosely viewed by the idly curious suffering from overhead expense. Platinum took its toll and the by-products of copper refining stood out clearly.

The Kalbfleisch Corporation, New York, put its best foot forward in demonstrating the uses of its acid output by the government at this time. Samples including sulphuric, nitric and muriatic were apparent. Owing to the great expansion in the manufacture of analine colors in this country, the pure anhydrous sulphate of soda, a specialty controlled by the Kalbfleisch Corporation for the standardization of aniline colors, took on added significance. The company's exhibit of permanganate of soda, the manufacture of which has supplanted permanganate of potash, also assumed prominence. War activities in this concern have been extensive and now include the manufacture of crystal boro phosphate and satin white, neither of which were put out before the war.

The American Metal Company, Ltd., New York, featured production of molybdenum concentrates on a large scale. These included arsenic oxide, coal, copper, copper sulphate, ferro alloys, gold, lead and antimonial lead, tin, tungsten concentrates, zinc dust, zinc oxide, zinc sulphate, etc.

Considerable pains and effort was apparent in the exhibit of the Hardinge Conical Mill (New York) Company, which was larger than in previous years. A model of the mill in glass showed the working of the mill. A combination iron and steel lining took precedence as something new and highly practical.

The Sturtevant Mill Company, Boston, Mass., turning out a huge volume of crushing, grinding, screening, weighing, dry mixing, elevating, sacking and conveying machinery, had a big display at the exhibit, shown by full-sized machines or working models. An "open-door" labor-saving appliance was one of the big features of the Sturevant lay-out.

The Powdered Coal Engineering & Equipment Company undertook successfully to demonstrate its machine as applied to metallurgical work, forging, heat treating, etc. The machine can be automatically or manually controlled and can also be governed by a thermostatic control.

PERSONALS

ITEMS OF INDIVIDUAL INTEREST

H. C. Loudenbeck, has accepted the position of metallurgist of the Westinghouse Air Brake Company, Wilmerding, Pa., to fill the vacancy left through the resignation of Zeno D. Barnes.

Leonard W. Egan, formerly special engineer with the Wellman-Seaver-Morgan Company, has severed his connection with that concern and has become associated with the Electric Furnace Company, Alliance, Ohio.

Zeno D. Barnes, who for the past three years has been connected with the Westinghouse Air Brake Company, Wilmerding, Pa., as non-ferrous metallurgist, is now connected with the General Operating Department of the Aluminum Castings Company, making his headquarters in Cleveland, Ohio.

Charles E. Beardsley, manager of the Waterbury Brass Branch of The American Brass Company, Waterbury, Conn., has resigned his position with that company and on October 1, will take up his new duties as manager of both the Novelting Manufacturing Company of Waterbury, Conn., and the Risdone Tool and Machine Company of Naugatuck, Conn. Mr. Beardsley is also president of both of these concerns.

DEATHS

EDWARD RANDOLPH

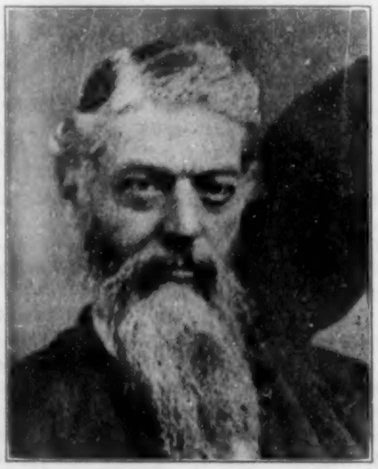
Edward Randolph, head of the Balback Smelting and Refining Company, whose home was at Hotel Bretton Hall, New York City, died suddenly at the company's plant in Market street, Newark, N. J., October 11, 1918, of apoplexy. He was 47 years old.

CHARLES G. ROEBLING

Charles Gustavus Roebling, president of the John A. Roebling's Sons Company of Trenton and Roebling, N. J., and of the New Jersey Wire Cloth Company, Trenton, and vice-president of the John A. Roebling's Sons Company, New York, died October 5 at his home in Trenton, aged 69 years. Mr. Roebling was born in Trenton, graduated from Rensselaer Polytechnic Institute in 1871 and for a number of years was mechanical engineer of the John A. Roebling's Sons Compnay. With his brother, Washington Augustus Roebling, he had a large part in the completion and construction of the Brooklyn bridge, which was started by their father, John A. Roebling. He was also actively identified with many other engineering projects.

HENRY STRATTON

Henry Stratton died at his home in Bridgeport, Conn., on October 3. Mr. Stratton was born on October 24, 1824, at Northfield, Mass., and at the time of his death, was upwards of ninety years old. He was an electro-plater of considerable merit and had been foreman for Bradley & Hubbard, of Meriden, Conn., for a great many years and was well known among the old electro-platers. When Mr. Stratton first started out in commercial life, there were no electric generators as used at present to be had, and the platers of his day had to depend on the Smee battery set up in series, but in spite of all the handicaps of this nature the work turned out at that time, it is said, would be a credit to any plater today.



HENRY STRATTON.

Mr. Stratton is survived by his son, W. G. Stratton, foreman plater of R. M. Bassett & Company, Shelton, Conn., formerly president of the Bridgeport Branch of the American Electro Platers' Society and past vice-president of the supreme body of that society.

TRADE NEWS

BUSINESS REPORTS OF THE METAL INDUSTRY CORRESPONDENTS

WATERBURY, CONN.

TIMOTHY F. BARRY

It is with deep regret that we record the death of Timothy F. Barry, Waterbury correspondent for THE METAL INDUSTRY, who died in Waterbury, Sunday, September 29, of injuries which he received in a trolley wreck two days previously. Death was due to internal injuries. Mr. Barry had been secretary of the Waterbury Chamber of Commerce for 18 months and was active in all branches of war work. He was food administrator for Waterbury, publicity director of the various Liberty Bond drives and was a prominent member of nearly a score of patriotic committees. For seven years prior to his appointment as secretary of the Chamber of Commerce he was editor of the Waterbury *Republican*. Mr. Barry was born in New Haven on November 13, 1882, a son of Patrick and Mary Barry. He attended the New Haven public schools and Yale College, being graduated from the latter institution in 1904. Throughout his school and college years, he spent his spare time in newspaper work. In 1902 he made a trip as correspondent on the Roosevelt special. After his graduation from college he became city editor of the New Haven *Palladium*. Later he went to Waterbury and entered the employ of the *Republican*. He became city editor in 1906 and night editor in 1908. From 1910 to 1917 he was managing editor. In 1916 he attended the training camp at Plattsburg. His wife, who was Miss Grace Tiernan of New Haven, and one daughter, Frances, survive. He also leaves his parents, one brother and three sisters. The Waterbury papers joined in glowing tributes to the young man. The Waterbury *American* in the course of a column article said:

TIMOTHY F. BARRY.

"It is needless to tell of the fine principles, the splendid character, the industry, the enthusiasm, all the qualities that go to the making of a splendid citizen, that characterized Mr. Barry. All who knew him knew of them, for they were obvious even upon a slight acquaintance with him."

METAL INDUSTRY readers will doubtless remember that all of the qualities mentioned by the Waterbury *American* that go to the making of a splendid citizen were also represented by the pen of Mr. Barry in the splendid letters be wrote for THE METAL INDUSTRY on the industrial conditions of Waterbury and the Naugatuck Valley.

The Connecticut Brass & Manufacturing Corporation of Waterbury, Conn., has been placed in the hands of a receiver, appointed in an equity suit of the Equitable Trust Company of New York. When in November, 1917, the Connecticut Brass Company of Cheshire, Conn., was merged with the Pilling Brass Company of Waterbury into the Connecticut Brass & Manufacturing Corporation, an immediate expansion of the building, equipment and business of the two plants resulted. There followed a large influx of orders, which included brass rolled to thin gages, brass discs and base covers, the majority of which were for the United States Government by direct or indirect contract. The construction work was so delayed and the labor situation so bad that it was found that the output of the two mills had been greatly oversold.

In order to conserve the assets of the corporation and to hasten a solution of its production and sales problems, the directors asked that receivers be appointed. David J. Reinhardt, Attorney General of the State of Delaware, and William H. Coverdale of the firm of Coverdale & Colpitts, New York, were designated. On September 4, by decree of the United States District Court for the District of Connecticut, Mr. Coverdale was appointed auxiliary receiver for the Connecticut Brass & Manufacturing Corporation's plants and properties in the District of Connecticut. He is at present conducting the business of the corporation.

BRIDGEPORT, CONN.

OCTOBER 14, 1918.

The strike which occurred in Bridgeport during the last month caused serious delay in the output of many of the factories. New men were put in the strikers' positions in most cases in order that production should not be stopped altogether. When the order came from President Wilson for the men to go back, there was quite a bit of trouble before they were all reinstated at their old jobs or placed in similar new ones. Many who had left the city returned because factories in other places refused to employ Bridgeport munitions workers. Nearly all factories signatory to the Eidlitz award have already begun payment of retroactive wages and have made payment under increased wage.

Approximately 76 per cent. of the man-power of this city stands enrolled on Uncle Sam's books for either actual fighting or for whatever other war work necessary. That means more than three-quarters of the men in the city are now registered for war work, or, reduced to figures, it means that of the estimated total man-power of 70,000 in the city all but 17,000 are already under registration and may be called for any war work that Uncle Sam needs them for. This causes a great dearth in the factories. There has, of course, been a big influx of population into the city since, and particularly a large number of men attracted here by the abundance of work and good wages paid in the big munitions-making factories.

Bridgeport holds a unique position in the matter of draft quotas, and is probably hit as hard as any city in the United States in proportion to the size of population and general conditions. There are those that believe that Bridgeport is furnishing a greater percentage of its man-power than any other city, town or community in the country. Through an error, made when allotments for the first draft were made, Bridgeport was credited with being a city of 250,000 population, and its quota was based on that population. As a matter of fact, 170,000 is actually the population as nearly as can be estimated. So Bridgeport's quotas are as large as any city with a quarter of a million population, and the citizens are accepting the situation patriotically and without a word of complaint or protest. A canvass of the city has been made soliciting women for munitions work, and up to date 7,174 women have registered for war work. The last draft will drain all the factories, and women are being employed to take their places as much as possible.—L. M. P.

NEW BRITAIN, CONN.

OCTOBER 14, 1918.

The United States Government, through the War Department, comprising both the ordnance and engineering sections, continues to place large contracts for supplies with the big manufacturing concerns in this city and vicinity. A partial list of the more recent contracts received, indicating the enormous output of war goods that the local concerns are producing, is herewith printed: North & Judd Manufacturing Company, snap hooks and rings; Bristol Brass Company, Bristol, Conn., cartridge cases and discs; Landers, Frary & Clark, canteens and cup handles, and also service drinking cups; Stanley Rule & Level Company, nail sets, and also for smoothing jack planes; Traut & Hine Manufacturing Company, brow band ornaments, and also cartridge belt guides; R. Wallace & Sons, Wallingford, service forks; Marlin-Rockwell Company, machine guns; Grant Hammond Company, New Haven, Conn.; bolos; Foster Merriam Company, Meriden,

Conn., bayonet scabbard washers; Manning & Bowman, Meriden, Conn., adapters and boosters.

These contracts, which represent only a small fraction of the war orders that have been received by local concerns, are of sufficient size to warrant the factories operating full time, and in some cases overtime. Landers, Frary & Clark have been rushed with war orders to such an extent that it has been necessary to curtail the production of domestic acticles. Traut & Hine and the North & Judd Manufacturing Company have been working on war orders for several years, and the former concern has been compelled to open a branch factory in Collinsville. This concern is now preparing to take over the manufacture of a new product, part of the working equipment of the Browning machine gun. The New Britain Machine Company continues its extensive work on shell caps, anti-aircraft guns, machine gun parts, etc., and the new factory, recently built in record time, is now occupied. The P. & F. Corbin factory is a hive of activity in both domestic and war-time goods. This concern, whose large brass foundry was burned down more than a year ago, is now making every effort to get a Government permit to erect a new brass foundry adjacent to their plant on Park street. All is in readiness to begin work as soon as a permit is issued. It is understood that this foundry will be of modern construction and will probably measure about 200 x 400 feet. The site is so located that a spur railroad track would run beside the building. The Corbin Cabinet Lock Company, while not making articles used on the battle lines, is nevertheless shipping large quantities of its products to the Government depots in this country and in France. These consist of locks, fasts and post-office equipment, and all orders are for stock of the very best material.

There is seemingly no semblance of labor troubles in this city, and although there is a trade union here, and efforts are being made to increase its membership, there seems to be no trouble brewing. The only labor trouble here, and as the calls for men for the army increase so does this trouble increase, is a shortage of labor. Women are employed in large numbers in all of the factories, and the Government has just opened up a federal employment agency in this city, as elsewhere, in an attempt to provide the more essential manufacturing establishments with sufficient skilled labor, as well as ordinary labor.—H. R. J.

TORRINGTON, CONN.

October 14, 1918.

General conditions in the metal industries in Torrington are satisfactory in view of the state of the markets and the shipping situation.

Coal shipments are being pushed through rapidly. In fact, so far as fuel is concerned, Torrington is better off than many other communities, the September and October allotments of bituminous and anthracite coal for factory use having been received in full by October 1.

Wholesale prices on chemicals have advanced about six per cent. in the last 30 days, but shipments are fairly good, with the exception of mixtures having potash for their foundation.

The Torrington Company has opened its home on Main street for its women employees. The building was formerly used for hotel purposes. It has a capacity of about 100.

The Torrington Manufacturing Company has secured a permit from the Board of Warden and Burgesses for the construction of an oil and lacquer addition. The addition will be one story high, of brick and concrete construction, 10 x 25 feet, and will adjoin the plant on Franklin street.

The Coe Brass plant of the American Brass Company is now working Saturday afternoons. The following notice has been sent to each employe:

"To the officers and employes of the American Brass Company:

"The necessities of the Government and their demands upon our company for material are becoming greater each day. Owing to our inability to obtain a sufficient number of men and women to operate our mills to their full efficiency, we are unable to do what the Government might otherwise reasonably expect from our company. The situation is serious, and we should all feel like exerting ourselves to the utmost to supplement the heroic efforts of our boys in France on the firing line by contributing in every way to insure a supply of necessary munitions for them. Nothing that we can do here will begin to equal their hardships and devotion to the cause, and their loss of all home comforts, even the supreme sacrifice which they may be called upon to make.

Further than this, neglect of duty, indifference about work, lack of interest, absence from any cause other than serious illness, should be avoided; in fact, such tendencies will be made the subject of investigation by the Government.

"In order to increase our productions we must increase the hours in which our mills are operated and should discontinue the present practice of losing four hours every Saturday afternoon. Relying upon the patriotism of all to cheerfully adopt the change we propose to begin Saturday, October 5, to run the mills and keep our offices open for business from 1 o'clock p. m. until 5 o'clock.

"Our mills are now working almost altogether on Government orders directly and indirectly, and this contribution of effort we hope will be loyally and cheerfully made by all.

"Charles F. Brooker, President."

The effects of the war on labor conditions in Torrington manufacturing plants is indicated by a comparison of figures obtained by the factory committees in the Liberty Loan drive in October, 1917, and the Fighting Fourth drive this month. The committees compiled figures showing the number of employees in each plant. These show that there has been a falling off in the number of employees in most of the plants during the past 12 months. Following is a comparison of the two reports:

	1917	1918	Decrease	Increase
Union Hardware Company	870	610	260	..
Standard Company	582	727	..	145
Hendey Machine Company	900	859	41	..
Torrington Manufacturing Company	193	184	9	..
Hotchkiss Brothers Company	150	113	37	..
Progressive Manufacturing Company	161	125	36	..
Excelsior Needle Company	1,076	1,296	..	220
Fitzgerald Manufacturing Company	131	150	..	19
American Brass Company	2,500	2,510	..	10
Turner & Seymour Mfg. Company	800	550	250	..

The net decrease, according to these figures, is 247. It is due, not to lack of work, but to lack of men.

As in previous campaigns, the factories are co-operating splendidly in pushing the sale of Liberty Bonds among their employees.

Work is progressing rapidly on the construction of the new plant of the Fitzgerald Manufacturing Company on North Main street. A description of the new building was published in the September issue of The Metal Industry. The work was delayed slightly in starting owing to scarcity of labor.

A total of 4,225 men between the ages of 18 and 45 registered in the Torrington district for the new draft.

Two large oil storage tanks are being constructed at the Coe Brass Branch of the American Brass Company. The tanks will be of reinforced concrete, 50 feet in diameter and 10 feet high, and will have a capacity of 200,000 gallons.—J. H. T.

PROVIDENCE, R. I.

October 14, 1918.

The labor shortage, which has been so noticeable for many months in this city and vicinity, is being met in a large number of the industrial plants, including the various metal working lines, by the employment of women and girls. In some instances entire departments have been practically given over to female help, and the numbers are being constantly increased as the men leave to go into active military or naval service or take employment in war industries.

As has been the case for more than four years, the unprecedented period of capacity activity among the metal plants continues unabated, in many instances orders accumulating faster than they can be filled and shipped. Wages never were higher in the history of labor, yet there is an apparent unrest among the operatives, who seek material advances in their pay at the same time asking a curtailing of the hours constituting a day's work.

The manufacturing jewelers of Providence report that business is the best that has been experienced in many years, the most significant and interesting feature of the situation being that it is the shops producing the gold and better grades of goods that are the most active, while, at the same time, the demand is constantly increasing in anticipation of the approaching holidays. The problem of labor with the manufacturing jewelers, instead of showing any improvements, is becoming more and more acute and perplexing. The reason for this is not only in the loss of so many of the male employees who are within the draft age, but also because of the calling of able-bodied men (9,460 being requisitioned from this community) to take up more important "essential" work in order to assist the Government in its war policies.

The munition factories and all the plants and factories here engaged in Government or war work, especially of a metal character, are being driven at full speed, in many cases by two and three shifts daily, and yet are unable to keep pace with the demands for their production.

The Fairmount Foundry Company has filed with City Clerk Paquin, of Woonsocket, a certificate of a change of name of the corporation to the Fairmount Foundry and Engineering Works. The certificate shows that the corporation has an authorized capital stock of $50,000, of which amount $38,000 has been paid in.

A permit has been issued from the office of the Inspector of Buildings to the Nicholson File Company to erect two one-story brick additions to two of the buildings connected with the present plant on Acorn street, this city. One of the additions is to be 22 by 49 feet and the other will be 25 by 31 feet.

The directors of the American Screw Company have declared the regular quarterly dividend of 1¾ per cent. and an extra dividend of 2 per cent. on the capital stock of the corporation, payable on and after September 30 to stockholders of record September 23. With these payments the company will have disbursed to its stockholders $11.25 per share for the three quarters of 1918. In March an extra dividend of 4 per cent. was declared, but in June only the regular dividend was paid, as expected. The final payment for the year will fall due in December.—W. H. M.

MONTREAL, CANADA

October 14, 1918.

Activity in the metal manufacturing lines for the month of September was very gratifying, and prices showed an upward tendency, and that the delivery of raw materials was greatly improved.

The tin market is somewhat easier, and declines from 5 to 7½ cents per pound are noted in some quarters. Buying is rather limited owing to uncertainty still prevailing in regard to Government action. There were rumors that intimated that the United States was to get two-thirds of the available supply. The latest report from Ottawa is that the British Government may handle the entire output of product in tin, appointing one importing firm as its agent. This would probably work out to best advantage, as a more accurately gauged basis of the available supply could be secured and allocations made to essentials in the order of their importance. Solder has dropped down 1 cent per pound in sympathy with lower prices of tin.

The large brass manufacturing plant of the Robert Mitchell Manufacturing Company, Ltd., located at St. James street and Belair avenues, is running to its full capacity and working overtime three nights per week to keep up with the business they have on hand.

There is a heavy demand for electrical brass goods at the present time, and the Northern Electric Manufacturing Company is running its plants to full capacity.—P. W. B.

CINCINNATI, OHIO

October 14, 1918.

The outstanding feature of the various activities of the metal trades in this vicinity, notably, of course, the big machine-tool makers and the foundries and other concerns which aid their work, is the extent to which the Government is dominating the market. For several years the demand for tools and equipment by munition plants has been responsible for remarkable business for the manufacturers of these goods, and this has been emphasized greatly since the United States entered the war and became a large buyer of war supplies. Within the past few months, however, in order to secure the equipment of munition plants as rapidly as possible, and to secure supplies for the Army and Navy with the least possible delay, the Government seems to have adopted the policy of undertaking itself to make arrangements for the equipment of plants built or to be built to make arms, munitions and supplies of various sorts. That is, instead of leaving it to the contractors themselves to go into the open market and secure the needed mechanical equipment for their plants, the Government has taken lists of the tools and machinery wanted and gone to the trade with these lists. This has been especially true of the Navy Department, whose large orders for machine tools have been an outstanding feature of the market for some time. Systematic distribution of these lists to the trade through chambers of commerce and other business organizations, as well as by publication in trade journals, has had the effect of placing them before the public, and before the manufacturers interested, with the minimum of delay. Moreover, the imposing length and proportions of these lists have naturally drawn the attention of tool makers, as they tended to increase the apparent desirability of the business. In short, the plan of having the Government itself do the ordinary for the plants engaged in Government work has been extremely successful, at least from most standpoints. It has, however, tended to eliminate the buyer who wants only a few tools, by inducing him, if engaged on Government work, to get the department for which he is working to secure his tools, and, on the other hand, it has made it difficult, almost to the point of impossibility, for the machine-tool plants to accept small individual orders except for delivery months hence. The manufacturers are loaded with business, and are working at top speed to turn out their products and get to the long lists of orders booked ahead.

The work of the Fourth Liberty Loan is receiving its full share of attention from the members of the metal trades in this vicinity, and virtually all of the manufacturers have not only subscribed liberally themselves, but are aiding their employees to buy bonds on small weekly payments, as heretofore. The machine-tool manufacturers realize fully that much of their present prosperity has grown directly out of the war, and that their large receipts come, either directly or indirectly, from the Government, and hence from the proceeds of the big loans which have been floated. Their subscriptions, therefore, have been correspondingly generous.

Extensions and improvements on the part of manufacturers of tools, engineering specialties and the like are probably the most active department of the building field in Cincinnati just now, as other work, not considered necessary, is frowned upon by the Government authorities. Several projected increases by machinery manufacturers, even, have been indefinitely postponed, on account of the extremely high cost of building, and the difficulty of securing labor to handle the work.—K. C. C.

COLUMBUS, OHIO

October 14, 1918.

Steadiness characterizes the metal market in Columbus and central Ohio territory. Buying is steady, and owing to reduced shipping facilities there is a shortage in certain metals, notably tin and allied metals. The demand from all metal-using concerns is holding up exceedingly well, and this with reduced receipts is causing some inconvenience. But on the whole the tone is satisfactory and the future looks rather bright.

Government price levels prevail on most of the metals, including copper, aluminum, lead and spelter. Brass is one of the strongest points in the market, and the demand is especially strong during the past few weeks. Copper and zinc are also in good demand, and the same is true of aluminum. Babbitt and type metals are also moving well under the circumstances. Dealers in those metals are experiencing considerable difficulty in getting shipments.

Metal dealers and agents believe that things will become tighter as the winter arrives and shipping is still further reduced. As a result some of the consumers are trying to accumulate stocks to be in a position to go ahead, even if shipping is restricted.—J. W. L.

CLEVELAND, OHIO

October 14, 1918.

With the fourth Liberty Loan on, and Cleveland's quota $112,000,000, nearly double that of the third Loan, it is fairly safe to say that no line of business in this county is lending better aid to the movement than the metal industry. This is but a reflection of the response that has come from this industry to all war movements, including the Thrift Stamp campaign. The chief reason that can be assigned to this response is that workers in the metal industry here are the chief beneficiaries, in the matter of increased wages, as a result of the war work placed in practically every plant here.

Example of this willingness to aid the Government that has made for their better living is illustrated at the W. M. Pattison Supply Company, according to reports of the chiefs of the stamp committee here. Although the quota for employes of this plant is $200, 200 employes have agreed to buy $600 stamps each week until January 1, 1919. This means this is a 300 per cent plant, and breaks all records. The Cleveland Furnace Company is a close second, with a record of 281 per cent, and the C. O. Bartlett and Snow Company third, with 191 per cent record.

Leading firms allied with the metal industry are doing their bit as well by contributing to the publicity campaign in local newspapers. A few of those who have subscribed to this part of the Liberty Loan campaign work are:

The Standard Parts Company, the Cleveland Wire Spring Company, the Cleveland Pneumatic Tool Company, the Cleveland Automatic Machine Company, the Cleveland Metal Products Company, the Cleveland Milling Company, the Templar Motors Corporation, the Hydraulic Pressed Steel Company, the American Multigraph Company, the American Fork & Hoe Company, the National Malleable Castings Company, the National Tool Company, the Electric Controller & Manufacturing Company, the Warner & Swasey Company, the White Company, the Forest City Machine & Forge Company, the W. M. Pattison Supply Company, the Parish & Bingham Company, the Ohio Blower Company, the Willard Storage Battery Company, the Chandler Motor Car Company, Grant Motor Car Corporation, the Cleveland Twist Drill Company, the Cuyahoga Stamping & Machine Company.

Plans for linking up the shops and factories of Cleveland with the school system of the city, whereby boys and girls of school age will be able to obtain practical vocational training, has been started by the Board of Education here this week. The plan probably will be in operation by the beginning of the year, from present indications. The system, as outlined by Vocational Director Fletcher, and R. I. Clegg, member of the Board of Education, will be to have students in technical branches of study receive part-time instruction in factories, under the tutelage of skilled mechanics and craftsmen in the manufacturing plants. Several factory heads have announced their willingness to cooperate, and the aid of labor unions, in having their members impart some of their knowledge to the students, will be sought. Arrangements already are under way with plumbers and steam fitters to give courses to students at technical high schools. W. M. O'Brien, business agent of the sheet metal workers, is arranging with his organization to the same end.

At the quarterly meeting of the National Association of Brass Manufacturers, held at Hotel Hollenden this month, plans for aiding the Government for the duration of the war were adopted. The members agreed to cut items of manufacture on water, gas and steam equipment to 100, instead of 1,200 as at present, and to adopt standard specifications for housings. This action followed the request of R. L. Humphries, chief of the building material section of the War Industries Board, according to President E. L. Strauss, of the association. At this meeting Adolph Mueller, Decatur, Ill., was appointed a member of the War Service Committee of the War Industries Board.

First step toward making quantity production of airplanes was taken here when the first plane put out by the Glenn L. Martin Company flew to Dayton in two hours. These will be regulation battle-planes. Wholesale production will start following receipt of instructions, after tests have been made by the Government at Dayton. The initial plane is operated by two 400 horse-power Liberty motors, and is said to be the largest war airplane ever constructed.

Another Cleveland airplane plant is about getting up to its capacity now. The Rubay Company has started to ship five carloads of De Haviland planes complete to Government aviation fields each week. These do not include motors.—C. C. C.

DETROIT, MICH.

October 14, 1918.

Practically every brass and aluminum concern in Detroit is now engaged on war work. This also includes the automobile companies who almost entirely have given up pleasure car production to devote their entire time to manufacturing airplane engines. Manufacturers have had their trials within the last year, due largely to unfamiliarity in the production of airplanes. It is gratifying now to state that period is past, and within the last month thousands of completed airplanes have been going from the Detroit shops.

Brass is playing a large part in these machines. It also is used heavily in ambulances which are being constructed by the thousands in two plants here. Tanks also are being produced in great numbers, and these also require brass, copper, aluminum and grey iron.

When peace comes how will these great manufacturing concerns be affected? This question is hardly ever asked as every one is too busy with work necessary for winning the war. Those who have discussed it seem to have no fear for the future. They look to a revival of the automobile to place business on a sound footing again. No one doubts what that will be.

Manufacturing plants seem to have obtained their winter's supply of coal so that nightmare is passed for the time. The greatest trouble now is railroad transportation and inability to obtain supplies. There seems to be prospects of further curtailment in many lines of raw material. However, plants engaged in war work have little fear as to the future in that regard.

Construction is under way in Detroit of a new style of electric melting furnace designed by H. W. Gillett, a government chemist. It is said the new furnace will materially reduce the cost of making brass for munitions. It is reported that six of these furnaces are being installed here.—F. J. H.

LOUISVILLE, KY.

October 14, 1918.

Louisville brass and copper plants are exceedingly busy at the present time and are securing more business than they can handle, with the result that there is no drive being made just now for additional business. Much direct or indirect Government work is coming into the plants. There is also a good demand for special castings and foundry work of one sort or another from local manufacturers, who are having trouble in placing their orders.

Due to the reduction in the manufacture of pleasure automobiles, and trouble and time lost in securing parts from manufacturers, along with the fact that many old models are being rebuilt into semi-modern cars, there has been an unusually active demand for special castings of bronze, babbitt metal, etc., from local repair shops, machine shops, etc.

The Vendome Copper & Brass Company reports a very busy season, and is installing additional motor-driven machinery to enable it to get out work in better time.

The house of Matt Corcoran & Company has about completed a large addition to its plant, which was made necessary in handling war orders.

The Independent Brass Foundry is working night shifts at the present time in order to keep up with the heavy demand for castings. The company has a number of indirect Government contracts for flushing valves, metallic packing, and specialties.

During the past two or three months a number of old distilleries have been wrecked in order to get the engines and boilers which are in demand at exceedingly high prices for used machinery, due to the scarcity of such material. This has also produced large quantities of excellent heavy copper. Old stills, which cost thousands of dollars to erect, and which are now practically useless, are bringing a much better price as scrap

than could be realized at any other time, and owners are taking advantage of the opportunity. Indications are that the national prohibition movement for the period of the war will result in prohibition for all time, and a great many more breweries and distilleries will probably be dismantled, or converted for other purposes.

The Edwards Development Company, of Hopkinsville, Ky., with a capital stock of $150,000, has been incorporated to manufacture metal aeroplane parts, including an improved bombing device. D. G. Edwards is the inventor and principal stockholder.

A new copper and brass working concern kown as the Floatless Carburetor Company, of Lexington, Ky., has been incorporated by Ernest J. Hifiner, Victor R. Dodge, Ernest B. Bradley and others, to manufacture carburetors and engines.

Metal-working shops of Louisville are now paying first-class metal workers around $7.50 a day, while machinists are getting more. With labor being paid at from sixty-five to seventy-five cents an hour, it has become necessary in many shops to charge labor at $1 an hour on job work. The automobile repair shops in most cases are now operating on the basis of $1 an hour.

The Stege Manufacturing Company, of Louisville, platers, enamelers, machinists and metal finishers, report an excellent business, and in fact about all that can be cared for considering the shortage of labor, and inability to secure good men.

Federal and state agents are investigating carefully the $40,000 fire loss at the plant of the William J. Oliver Manufacturing Company, at Knoxville, Tenn., which is busily engaged on shell and other Government contracts. Prior to the war this plant manufactured plows exclusively.—O. V. N. S.

PHILADELPHIA, PA.

October 14, 1918.

A contract has been awarded to the American Metallurgical Corporation, Franklin Trust Building, by the Aircraft Division, War Department, for the installation of a special heat treatment equipment at the plant of the Ohio Seamless Tube Company, Shelby, Ohio.

The Ajax Metal Company, 46 Richmond street, are having plans prepared for alterations to their plant on Beach St., to cost approximately $3,500.

John W. Watson, of this city, and president of the American Bronze Company, Berwyn, Pa., and former chairman of the Pennsylvania Section, Society of Automotive Engineers has been appointed assistant chief of the Hispano-Suiza Engine Section of the Bureau of Aircraft Production. In the absence of the chief, Mr. Watson is responsible for the administration of this particular section which includes engineering, production and inspection activities for the government in connection with the production of Hispano-Suiza engines and spares. He will make his headquarters in New York.

The scarcity of lead is being felt in the trades here and distribution is said to be restricted to government requirements. Demands greatly exceed the supply and the shortage in available supplies is said to be due to the inadequate labor supply which has cut production. There is nothing to foresee how this can be remedied to any great extent, the local trade understands, and for that reason believes that conditions will remain as bad as they are until the labor situation clarifies which is very uncertain as to when. The lead committee which has charge of the distribution is making it by allotment. Prices are at the government established basis.

Trading in spelter is reported as quiet. Prices are steady and there is no disposition upon the part of sellers to urge purchases and prices are not being shaded.

The market for pig tin is dull. This market is on a waiting basis and is awaiting the outcome of government control. If tin is not ordered now and imported, there will be a great scarcity by the end of the year, the trade say.

The price question is taking the attention of the copper trade. They await the result of the conference with the War Industries Board which is to be held in Washington, October 15. At that time it is expected that a price will be determined upon to be made operative on and after November 1. Some in the trade predict an advance and base their statement upon the shortage of supplies as against the requirements. Others say that as production is a matter of labor and they doubt that even an increase in the price of copper would make any change in the situation. Some say that it is known that the government is not in favor of price changes and believe that the prices now prevailing will be continued. Refiners still confine distribution to government requirements and are making every effort to conserve material.

There is a fair demand for antimony and the market is reported as steady. Trading is largely between dealers. Prices are reported as unchanged over last month.

The General Machine and Manufacturing Co., of this city, has been incorporated in Delaware with a capital of $20,000 by R. R. Biddle, J. H. D. Eagan and C. H. Rubican.

Metal trades of this city are busily engaged on the Fourth Liberty Loan campaign. The first four days of the campaign the metal working industries committee turned in $345,850. In addition Merchants and Evans subscribed $60,000.

Where government work is engaged in by plating firms in this city they are busy but this work is mostly in spots. Civilian business is moving slowly and some firms are finding it difficult to keep their plants in operation despite the scarcity of labor. The restriction by the war industries board of the use of nickel parts as ornaments on many products is being felt by the plating trades, whose business has been mostly of this character. Cutting down in building work has reduced plating work upon fixtures to a minimum.—F. W. C.

TRENTON, N. J.

October 14, 1918.

The plant of the M. M. S. Metal Company, owned by Morris Movshovitz & Son and situated along the banks of the Delaware River, Trenton, N. J., was gutted by flames early in September, resulting in a loss of about $25,000. A storehouse belonging to the concern was also burned, only the four furnaces in the smelting plant being left intact. A new engine and expensive motor, installed shortly before the time of the fire, were ruined. The plant is being rebuilt on a modern scale. The structure was two stories in height and was L-shaped. Two of the floors were used for the storage of oxide and zinc and contained a big supply. Considerable of this was to have been shipped away the day before the blaze. The metal concern has plenty of orders on hand and was operating the plant night and day. The fire will cause a great setback, but the company hopes to catch up with the work with an increased force. All the company's auto-trucks were saved.

The Trenton metal industry plants are preparing to do their share towards the Fourth Liberty Loan drive. The drive will be carried on along larger lines than heretofore and committees will not only visit the homes in the canvass, but also the different manufacturing plants. The mechanics are now receiving large wages, and while hundreds of them pay cash for Liberty bonds, many are still paying on old bonds. Workmen in the metal plants are very patriotic, and during the other three Liberty Loan drives they "went over the top" and were placed in the 100 per cent. class of subscribers.

Under the new drastic order issued by the Government all men now engaged in non-essential plants will be rounded up and placed in the essential plants. This will affect many mechanics in Trenton aand will take some out of the metal industry plants. Under the order officials of the employment service are directed to prepare and publish lists of non-essential positions now held by men that could be filled by women. Men who fail to get out of their present non-essential positions of their own accord and take up essential employment will be rounded up as slackers and officially branded as such. The majority of the Trenton metal plants are engaged in turning out Government work, and there its employees will not be molested.

The American Standard Metallic Products Corporation, with plants at Bordentown and Paulsboro, announces that it will erect boarding houses for its employees and homes for the officials at the South Jersey plant.

Robert T. Bowman, son of Robert K. Bowman, of the J. L. Mott Company, who has been attached to the Quartermaster's Department at Camp Dix, has been made a first sergeant in the Conservation and Reclamation Detachment. This new department was recently established for the purpose of reclaiming and repairing all damaged equipment, guns, cannon, etc.—C. A. L.

BROTHERHOOD IN INDUSTRY*

By John D. Rockefeller, Jr.

This is illustrated in the field of industry, where the spirit of Brotherhood is sorely needed.

In the early days of industry, the owner of a plant or business also discharged the functions of the board of directors and the officers, including superintendent and manager.

There were but few employees; they usually lived near by. It often happened that they had been brought up from boyhood with the owner, had attended the same school, had called him by his first name.

As a rule there was but one plant, and necessarily frequent contact between owner and employees occurred. When questions arose on either side, they were taken up at the next chance meeting and readily adjusted.

Under such conditions it naturally resulted that a spirit of Brotherhood was developed.

In modern industry the owner of earlier days has been replaced by thousands of stockholders, for no single individual can provide the capital required by the great industries of today.

Instead of a few employees, the workers are numbered by the thousands, tens of thousands and sometimes hundreds of thousands. They come from all sections of the country, and often represent many parts of the globe.

Instead of one plant, there are frequently many, scattered all over the country, it may be sometimes in foreign countries.

The result is that contact between owners and employees is practically impossible, and too frequently a chasm opens between them.

Instead of Brotherhood there has developed distrust, bitterness, the strike and the lockout.

Often, therefore, the conclusion is reached that Labor and Capital are enemies; that their interests are antagonistic; that each must arm itself to wrest from the other its share of the product of their common toil. This conclusion is false, and grows out of unnatural conditions.

Labor and Capital are partners; their interests are common interests; neither can get on without the other. Labor must look to Capital to supply the tools, machinery and working capital, without which it cannot make its vital contribution to industry, and Capital is equally powerless to turn a wheel in industry without Labor.

Neither can attain the fullest permanent measure of success unless the other does also, and the unnatural conditions, namely, the absence of contact between owner and employee, must be made as nearly normal as possible by the establishment of personal relations between the owners, represented by the officers, and the employees, representing certain of their fellow workers whom they themselves have chosen.

This principle of representation, including adequate machinery for the uncovering and early adjustment of grievances, was adopted some three years ago by the Colorado Fuel & Iron Company, one of the largest industrial corporations of the State of Colorado.

It has since that time been put into operation by the Standard Oil Company of New Jersey in all of its plants in various States; by the Consolidation Coal Company, one of the leading producers of anthracite coal, operating in several States, and by a number of other coal companies in the anthracite fields.

Furthermore, the adoption of the principle is being urged both by the National War Labor Board and the Fuel Administrator. The public is also coming rapidly to recognize and accept the principle as just and fair.

I am profoundly convinced that nothing will go so far toward establishing Brotherhood in industry and insuring industrial peace, both during the war and afterwards, as the general and early adoption by industry of this principle of representation, the favorable consideration of which cannot be too strongly urged upon leaders in industry.

*An address delivered before the Civic and Commercial Club, Denver, Colo., June 13, 1918.

But there is another principle even more fundamental, from which the idea of representation has been developed. It is this: "Do as you would be done by."

Some months ago I was one of a number of men who were asked two questions by a Commission appointed by President Wilson to deal with certain labor difficulties.

The first was: "What do you regard as the underlying cause of industrial unrest?"

The second: "What remedy do you suggest?"

I stated that in my judgment the chief cause of industrial unrest is that Capital does not strive to look at questions at issue from Labor's point of view, and Labor does not seek to get Capital's angle of vision. My answer to the second question was that when employers put themselves in the employee's place, and the employees put themselves in the employer's place, the remedy for industrial unrest will have been found.

In other words, when the principle adopted by both parties in interest is "Do as you would be done by," there will be no industrial unrest, no industrial problem.

Since the Colorado Fuel & Iron Company was perhaps the first to develop a carefully worked out plan of industrial representation, which was adopted by unanimous vote of the board of directors, and a seventy-eight per cent vote of the employees, and has now been in operation for about three years, it may be of interest to mention briefly some of the outstanding features of the plan, and some of the results of its operation.

1. The first outstanding feature of the plan, is the representatives, their conferences and committees.

By secret ballot representatives are chosen annually by the employees from their fellow-workers in each mining camp and each division of the steel mills, one for every one hundred and fifty employees, but never less than two in any camp or division.

The representatives, together with an equal number of the officers of the Company, hold conferences at least three times during the year in the several coal mining districts, and similar conferences are held in the steel plant.

There is also an annual conference of representatives and officers of the Company. Such a conference occurs with the employees of the mines as well as with the employees of the steel plant.

In addition there are in each district of the mining camps and in all of the divisions of the steel plant, four standing committees, each committee composed of three employees, selected by the representatives but not necessarily representatives themselves, and three officers of the Company. These committees can initiate business as well as consider such matters as are referred to them.

The Committees are: Committee on Co-operation and Conciliation; on Safety and Accidents; on Sanitation, Health and Housing; on Recreation and Education.

There is also an officer, known as the President's Industrial Representative, whose duty it is to visit currently all the mines and confer with the representatives. A similar officer performs a like function in the steel plant. These officers are also available for conference at any time at the request of the representatives.

Thus it will be seen that the employees, through their representatives chosen from among themselves, are in constant touch and conference with the owners through their representatives, the officers, in regard to matters pertaining to their common interests.

2. The second outstanding feature of the plan is the Employees' Right of Appeal.

Any employee with a grievance, real or imaginary, may go with it to one of his representatives. As frequently happens, the representative finds that there is no real ground for the grievance and is able to so convince the employee.

But if a real grievance exists or the employee is not satisfied, the representative takes the matter to the pit boss, the mine foreman or the mine superintendent, and in the majority of cases the questions are amicably and satisfactorily settled by one of them.

If not, however, it is the employee's right, through his representative, to carry the matter to the President's Industrial Representative, the District Committee on Co-operation and Conciliation, the District Manager, the Manager, or Assistant Manager, the General Manager, the President, and, as a court of last appeal, to the Industrial Commission of the State of Colorado.

Experience proves that the vast majority of difficulties which occur in an industry arise between the workmen and the subordinate officials with whom they are in daily contact, such as pit bosses or mine foremen.

These petty officials are sometimes arbitrary. But it is by their attitude and actions that the higher officers and stockholders are judged.

Obviously, then, the right of appeal from their decision is important, and even if never availed of tends of itself to modify their attitude.

3. The third outstanding feature of the plan which I would mention is the Employees' Bill of Rights.

This covers such matters as the right to caution and suspension before discharge, except for such serious offenses as are posted at each mine;

The right to hold meetings at appropriate places, outside of working hours;

The right, without discrimination, to membership or non-membership in any society or organization; and

The right of appeal, to which reference has just been made.

So much, then, for the outstanding features of the plan. What have been some of the results of its operation? In brief:

1. Uninterrupted operation of the plants and increased output.
2. Improved working and living conditions.
3. Frequent and close contact between employees and officers.
4. Elimination of grievances as a disturbing factor.
5. Good-will developed to a high degree.
6. The creation of community spirit.

A community spirit has been fostered in many ways.

Club houses have been constructed in a number of the camps, and are under the direction and operation of the Young Men's Christian Association. These buildings provide recreational and social facilities not only for the men and boys, but for the women and children as well.

There are bandstands in a number of the camps, and bath-houses in practically all of them. In several, dispensaries have been built and supplied with district nurses.

Schools have been improved—some would serve as models in any city, however progressive.

One of the most important features of the community life is the gardens that have been generally cultivated. This has been made possible by fencing around each miner's house a plot of ground which is developed in grass, in flowers, or in vegetables, and always adds interest and attractiveness to the home.

The fences thus built have cost more than $40,000; over $155,000 has been spent on club houses, either completed or under construction; and upwards of $50,000 on bath-houses; in other words, a total of a quarter of a million dollars has been expended in three years for these several items alone.

The community spirit is developing community pride and rivalry. Each camp has its band, its baseball team. Of late this spirit has manifested itself most gratifyingly in patriotic endeavors.

Over one thousand men in the Company have responded to the call to the colors.

To the Third Liberty Loan practically every man in the camps and in the steel works subscribed.

A total subscription of over $1,000,000 was received, in addition to some $700,000 subscribed to the two earlier loans; and a similar high percentage has been maintained in the recent Red Cross campaign, the usual contribution being a day's pay.

In one camp a notice was posted in the office window to the effect that subscriptions for the Red Cross campaign would be received. No soliciting was necessary. The notice was all that was required. Every man in the camp voluntarily came to the office and put his name down.

One must not fail to mention the splendid Red Cross auxiliaries which the women of the camps have organized, and in which they are working earnestly and effectively.

I have recently spent two weeks in visiting the twenty or more camps and the steel mills. I talked confidently with practically all of the representatives in the camps and mills. They assured me that all grievances had been adjusted to the satisfaction of the employees or were in process of adjustment, or that employees had been convinced that their grievances were not well founded.

The representatives expressed their own unqualified endorsement, approval and appreciation of the plan, which attitude they said was that very generally of the rank and file of the men, who constantly valued the plan more highly as they understood its working better.

In view, therefore, of the statements of the representatives, of my own observations, and the results obtained during the three years which have elapsed since the adoption of the plan, I believe it can be said with confidence that the plan is no longer an experiment, but a proved success; that, based as it is on principles of absolute justice to all those interested in its operation, its continued success can be counted on, so long as it is carried out in the future as in the past, in a spirit of sincerity and fair play.

It is a vital factor in re-establishing personal relations between the parties in industry and developing a genuine spirit of Brotherhood among them.

VERIFIED NEWS OF THE METAL INDUSTRY GATHERED FROM SCATTERED SOURCES

The Chase Metal Works, Waterbury, Conn., is building an addition, 40 x 320 feet, one story, to its plant and which they expect to use as a stock shed.

The Taunton-New Bedford Copper Company, New Bedford, Mass., has awarded the contract for the erection of a one story, 30 by 50 feet, addition to its plant.

The Aluminum Castings Company, 1850 Elmwood Avenue, Buffalo, N. Y., has awarded a contract for a one-story trimming works, 80 x 160 feet at its Elmwood plant.

The Metal & Alloy Specialty Company, 25 Illinois street, Buffalo, N. Y., Elmer Rae, vice-president and manager, is building a factory, 60 x 100 feet, two stories, of brick and steel, at Marion avenue and New York Central Railroad.

The Omolite Company, Inc., of Jamestown, N. Y., on September 23, 1918, was adjudged a bankrupt by Honorable John R. Hazel, judge of the United States District Court. The first creditors' meeting was held on October 9 to appoint a trustee.

The Hero Manufacturing Company, Gaul and Adams street, Philadelphia, Pa., manufacturers of metal goods, states that the government is putting up a building 200 by 200 feet for its use in filling certain war work contracts.

The Aluminum Castings Company, Cleveland, Ohio, has about completed the erection of a new extension to its plant and has placed contracts for an additional structure, 140 x 260 feet, to be used as a core room, and another new building 150 x 460 feet.

The E. R. Caldwell & Son Brass Company, 619 West Fayette street, Syracuse, N. Y., manufacturer of brass castings, etc., has increased its capital stock from $50,000 to $200,000. The company operates a brass, bronze and aluminum foundry and grinding room.

The Ansonia Manufacturing Company, manufacturers of brass goods from sheet wire and rod, Ansonia, Conn., is erecting a one-story addition, 40 x 140 feet, to its plant. The company

operates a spinning, stamping, soldering, polishing, plating and lacquering department.

The Central Brass Company, Cleveland, Ohio, has placed a contract for a one-story extension, 35 x 72 feet. The departments operated by this company include a brass and bronze foundry, brass machine shop, tool and grinding room and plating and polishing departments.

M. M. Pearlman & Company, dealers in metals, with offices at 2 Rector street, New York, recently purchased property in Philadelphia, Pa., and have erected a plant and warehouse, and also have taken a suite of offices at the Land Title building, Philadelphia, where all communications should be addressed.

The H. Mueller Manufacturing Company of Decatur, Ill., will build a reclamation plant at a cost of $20,000, to utilize its waste material. The company operates a brass, bronze and aluminum foundry, brass machine shop, tool and grinding room, and galvanizing, soldering, plating, polishing and lacquering departments.

The Buckeye Brass & Manufacturing Company, Cleveland, Ohio, maker of brass specialties, has moved its plant from Columbus Road to the building formerly occupied by the Cleveland Pneumatic Tool Company, at East Sixty-fifth street and Hawthorne avenue. The company operates a brass and bronze foundry and brass machine shop.

The Superior Bronze Company, Erie, Pa., has moved into its new foundry, which was erected at a cost of $15,000. About 100 additional employes will be taken on and the new equipment will enable the company to handle all kinds of bronze and aluminum castings. Besides a foundry the company operates a smelting and refining department, brass machine shop and grinding room.

At a patriotic gathering of the employees of the **Chase Metal Works of Waterbury, Conn.,** September 30, a large flag was raised with an inscription stating that the works is now an official auxiliary plant of the shipbuilding yards of the United States government. This announcement means that all employees of the Chase Metal Works are in government employ—essential government work.

The Cleveland Galvanizing Works Company, Cleveland, Ohio, has changed its name to the Chain Products Company. Its principal activities for some time have been the manufacture of welding chain and the new name was adopted as being more appropriate. The company will continue to operate its galvanizing department in addition to the manufacture of chain. The officers are F. G. Hodell, president and treasurer; H. H. Hodell, vice-president, and William F. Schneider, secretary.

The New Jersey Zinc Company, 55 Wall street, New York, reports that it expects to occupy the new office building which it is erecting at Maiden Lane and Front street on or about January 1, 1919.

The company states that the new headquarters will embody many novel and interesting uses of zinc, such as the use of this metal in the manufacture of the builders' hardware and trimmings in the place of the ordinary brass builders' hardware so universally used.

INCORPORATIONS

Business organizations incorporated recently. In addressing them it is advisable to include also the names of the incorporators and their residence. Particulars of additional incorporations may frequently be found in the "Trade News" columns.

To manufacture brass, bronze and aluminum products.—The Lincoln Way Brass Foundry Company, South Bend, Ind. Capital $18,000. Incorporators: Sherman P. Stults, Charles Heckathorn and Henry Johnson.

The Essex Brass Corporation, Detroit, Mich., has been incorporated with a capital stock of $100,000. The stockholders are Edwin C. Nagel, of the Michigan Lubricator Company; Louis A. Danziger, Detroit Smelting Company, and John H. Qualman.

To manufacture surgical instruments, foundry supplies and other specialties.—R. P. & C. H. McCully, 331 Van Buren street, Brooklyn, N. Y. Capital, $50,000. Incorporators: R. P., C. H. & R. F. McCully. A brass machine shop, stamping, brazing, plating and polishing departments are operated by this company.

To operate a brass, aluminum and bronze foundry, etc.—Murphy Aluminum & Bronze Foundry, Inc., Amesbury, Mass. Capital, $10,000. Incorporators: Norman Russel, president; William J. Murphy, treasurer and general manager, and William H. Clark, secretary. The company also operates a brass machine shop, grinding room and plating and polishing departments.

To operate a galvanizing business—The Ballard Galvanizing Company, of Seattle, Wash., was incorporated recently with a stock of $15,000, to take over the business formerly operated by H. A. Wisner. The incorporators of the new concern are H. A. Wisner, E. A. Jackson and H. H. Warner. The company plans to add several new departments before the close of the year.

NEW USE FOR HYTEMPITE

A new use has been discovered for Hytempite, the refractory material manufactured by the **Quigley Furnace Specialties Company,** 26 Cortlandt St., New York. A large pump manufacturer states that by employing Hytempite as a core wash he is enabled to save six hours a day in cleaning castings. Other uses for Hytempite are hot patching of furnaces and gas retorts, mending linings of furnaces and gas producers and mending of crucibles and boiler walls.

CRANE CO.'S NEW MONTREAL PLANT

R. T. Crane, Jr., president of the Crane Company of Chicago, Ill., and Bridgeport, Conn., on August 21 performed the interesting ceremony of turning the first sod for the foundation of the new building which will be the home of the Crane Company in Montreal, Canada. Mr. Crane was assisted by his wife, son and daughter. There were also a number of distinguished guests present.

The site of the plant is on the south bank of the great Lachine Canal, between Atwater and Cote St. Paul bridges. The property comprises ten acres of land and is bounded on the south by the Grand Trunk Railroad, on the north by the Canadian Pacific Railroad, and the Lachine Canal, thus affording most advantageous rail and water facilities for shipping purposes.

The plant when in operation will employ from 500 to 600 employees and it is the intention of the company to manufacture a full line of brass valves, steam brass goods, plumbing and gas supplies and which will be distributed to their branch houses which will be opened in the large cities of the Dominion. The buildings will represent an expenditure of approximately $750,000 which, with the cost of the property, makes an investment of over a million dollars.

Mr. Crane's reason for locating the plant in Montreal was because, after having looked over the principal cities in Canada, he came to the conclusion that the shipping facilities of Montreal outweighed those of other cities and that the market for skilled mechanics was very large. E. C. Townsend, vice-president and general manager of the Crane Company, was also present at the ceremony as was W. J. Wall, who has represented the company in Montreal for the past fifteen years.

PRINTED MATTER

Safe Practice.—The National Safety Council, Chicago, Ill., has recently issued two bulletins in the interest of safety for the workman. Bulletin No. 14 is devoted to descriptions and illustrations and suggestions for the use of goggles and eye protectors of various types. Bulletin 15 is devoted to freight elevators and safety appliances that may be applied thereto.

These bulletins may be obtained for ten cents each by addressing the National Safety Council.

Zinc Products—"Metals," "Pigments," "Rolled Zinc" and "Zinc Dust" are the titles of four little booklets which have just been issued by the New Jersey Zinc Company, 55 Wall Street, New York. These booklets are called the "Handy Reference Library of Zinc Products" and are descriptive of the various uses of zinc including zinc sheets, strips and plates used for the manufacture of various products, zinc dust for the production of high grade zinc coatings on iron and steel; zinc oxide for pharmaceutical purposes, etc., and the different metals put on the market by this company and which include Horse Head, Bertha, Sterling, Franklin, White Bronze and Nassau. Copies of these interesting booklets may be had upon request.

Monel Metal.—The Bayonne Casting Company, Bayonne, N. J., has issued a 47-page booklet containing excellent half-tones and descriptions of the various articles of manufacture for which monel metal can be used, some of which are as follows: Rods, castings, forgings, wire, annealed and hard, wire cloth, wire rope, ball bearings, strip stock, tubes, sheets, bolts and nuts, lag screws, screw machine products, tie rods, washers, nails and rivets, chains, golf club heads, etc. The booklet also contains a list of the physical properties of monel metal, a table showing the tensile and torsional strength of monel at varying temperatures as compared with other metals and alloys and some instructions for polishing and finishing. Copies of this booklet may be had upon request.

Merchants' Association Year Book.—The 1918 Year Book of The Merchants' Association of New York City, is being distributed among the members of The Association. It covers the activities of the organization from May 1, 1917, to May 1, 1918.

The predominating feature of the book is the space that is given to the war work done by The Association in co-operation with the Federal authorities. A large proportion of the energy and activity of The Association was devoted during the year to this kind of work.

The book contains alphabetical and classified lists of the members. The names of nearly all the leading commercial houses and financial institutions in New York appear on these rolls, together with the names of many individual professional men and others.

The membership of The Association now stands at the highest point in its history, with a total of 5,481.

CATALOG EXHIBIT

METAL STOCKS MARKET QUOTATIONS

New York, October 14, 1918.

	Par	Bid	Asked
Aluminum Company of America....	$100	$500	$600
American Brass	100	—	215
American Hardware Corp............	100	125	127
Bristol Brass	25	38	41
Canadian Car & Foundry, com.......	100	32½	33
Canadian Car & Foundry, pfd........	100	86	89
Eagle Lock	25	75	80
International Silver, com............	100	40	50
International Silver, pfd.............	100	72	78
New Jersey Zinc......................	100	225	230
Rome Brass & Copper................	100	300	350
Scovill Manufacturing	100	—	410
Standard Screw, com.	100	270	80
Standard Screw, "A" pfd............	100	103	—
Yale & Towne Mfg. Co..............	100	200	210

Corrected by J. K. Rice, Jr., & Co., 36 Wall street, New York.

METAL MARKET REVIEW

Written for The Metal Industry by W. T. Partridge.

COPPER DISTRIBUTION.

October 14, 1918.

Copper continues to be distributed by the Copper Producers Committee of the Producers' Association according to an arrangement which was entered into early in the year with the desire of the War Industries Board. This arrangement has proved very satisfactory to all concerned and has relieved the Metal Division of the War Industries Board of much detailed work but jurisdiction is still exercised by the Government. It will be recalled that regulation of the industry was begun by the Government late in September, 1917, when the price was fixed at 23.50c per pound. Subsequently, through the Geological Survey, the Board called for detailed statistics in regard to production imports, exports and stocks.

Later, the Government relied upon the Producers' Committee to regulate distribution of orders after first making reservations on ample tonnage to meet the direct war requirements of the United States and its Allies. No restriction was placed upon the sale of copper, either for nearby or for future delivery but before shipments could or can be made all details regarding the transaction must be submitted to the Copper Producers Committee and shipments are made only after the priorities sub-committee has given permission. Preference, of course, is given to consumers who are filling war contracts, either directly or indirectly. It is estimated that 95 per cent of the copper distributed to domestic consumers goes into the manufacture of war munitions. Orders for the latter, of course, are distributed by the Government through various departments, including the Army, the Navy, the Emergency Fleet Corporation and the War Industries Board.

COPPER.

Interest in the copper industry in September was centered in the statistical position of the metal in its application to war requirements. August figures, which became available recently, while showing reduced output at mines and smelters indicated maximum production of refined copper—233,000,000 pounds—the same amount produced in August, 1917, the record in the history of the industry. Crude copper output, however, was estimated only at 204,000,000 pounds in August, next to February and July the low monthly record of 1918, thus far.

Exports in August, exclusive of shipments to Canada were according to Custom House returns issued by the Metal Exchange, only 18,889 tons (42,300,000 pounds) the smallest tonnage since May, 1916.

Revision of the established copper price—26c. per pound effective until November 1—will be considered at a conference to be held October 15, between representatives of the War Industries Board and the copper producers. Business throughout September was quiet outside of war requirements.

TIN.

After many weeks of anxiety and difficulty in the tin market, relief is in sight, official announcement having been published that the War Industries Board will control the pig tin situation under a license system. Acting Chief of the Tin Section of the Board, has notified all dealers and users of pig tin that a license to do business is required; that a complete inventory of stocks on hand must be made and that supplies may be redistributed if it is found necessary to do so to equalize them for essential industries. Full details will be issued later. In the meantime, prices have declined from 83c. for spot Banca at the beginning of the month to 82c. per pound; 99 per cent. tin for October delivery was held at 80c. in the past few days No spot Straits metal could be obtained but Straits for importation was estimated at 72.50c. toward the close. Australian tin now on Pacific coast was offered at 80c. per pound for prompt delivery, at 78c. for October and at 75.50c. for November positions in first few days of September.

Production of Bolivian fine tin in the United States during July amounted to 2,100 tons as compared with 1,159 tons in July, 1917. First seven months, 1918, total output in this country was 7,858 tons. Arrivals at Atlantic ports in September were

1,025 tons to the 14 inclusive, and at Pacific ports, 2,620 tons to September 17 inclusive, making total arrivals reported, 3,645 tons.

SPELTER.

The spelter market was quiet early in the month at 9.50c. per pound, New York, 9:15c. East St. Louis for prompt and September metal. Later, considerable activity developed with rising prices that advanced 35 points to 9.85c. New York and to 9.50c. East St. Louis by the close of first fortnight, when the Government order for 6,000 tons prime Western was closed; the price paid was not given out. The Navy order for 1,000 tons was not reported closed and the French War Mission was understood to be negotiating for American spelter. A lull in buying with an increase of stocks indicated by the weekly statistics was followed by a gradual decline in prices which had carried to 9.15c. New York, 8.80c. East St. Louis, on October 7.

Exports of spelter in August, from all ports amounted to 4,467 tons according to Metal Exchange reports. Zinc ore was unchanged at $75 for high grade and at $50 to $55 for other grades.

LEAD.

Acute shortage of lead, in September continued, with sales and distribution under strict control of the lead producers committee, an unofficial organization working in close sympathy with the War Industries Board. Previously agreed upon prices, 7.75c. per pound East St. Louis, 8.05c. New York, prevailed for carload lots. Jobbers' prices prompt ex store New York were held at 8.55c. per pound, and less than one-ton lots at 8.80c. per pound New York. Lead ore was maintained at $100 per ton throughout the month. Labor shortage interfered with production.

Exports of lead in August were 6,348 tons from port of New York, 492 tons from Pacific ports, making a total of 6,840 tons.

ANTIMONY.

The antimony market was quiet in September with only moderate demand. Wholesale lots declined from 14c. per pound, duty paid, to 13.87½c. early in the month, while jobbing lots sold at 14c. per pound. During the remainder of the month, the price fluctuated back and forth between these figures according to the volume of buying. At the close, 14c. was asked for wholesale lots, duty paid for prompt and October, ⅛c. premium being asked for jobbing lots. Shipments from the Orient, in bond, c. i. f. New York, were held at 13 to 14c. per pound, this being higher than the New York parity. No buying was reported.

ALUMINUM.

The war demand for aluminum continued to be in excess of supply during September. Late in the month, the War Industries Board issued circular blanks to the trade requesting that definite and specific information be given concerning stocks carried, production and the character of consumption. In addition to the principal form, two others were enclosed; one on which to list the consignors from whom aluminum was received and the other giving consignees to whom material was shipped. Similar circulars are to be issued each month and must be promptly filled in and returned to the Non-Ferrous Section of the War Industries Board. The Government maximum price, effective until March 1, 1919, is 33c. per pound f. o. b. producing plants in United States, for ingots 98-99 per cent. pure for 50 tons or more; 33.10c. for carload lots and 33.20c. for 1 to 15 tons.

SILVER.

Exports of silver during August were heaviest of record—$23,000,000 as compared with $7,500,000 for same month in 1917. For first eight months, 1918, the outgo was $157,000,000 as compared with $52,000,000 for first eight months in 1917. Imports in August were $7,265,000 and $47,600,000 for first eight months, 1918, as compared with $5,680,000 for August, last year, and $27,250,000 for first eight months, 1917.

As a result of the recent heavy outgo of silver from the United States, the Federal Reserve Board has decided upon strict regulations to check it. Export licenses will be granted only for civil and military purposes of importance in the prosecution of the war. Exporters must certify that silver exported has been purchased at a price which does not directly or indirectly exceed $1.01½ per ounce, 1,000 fine, this price applies at the point or locality where the silver is refined in the United States. Importations are to be paid for at the same figures, applied from point of importation. The quotation in the New York market throughout the month was $1.01⅛ per ounce.

PLATINUM.

With the appointment of a Government Platinum Administrator—Raymond T. Baker, Director of the Mint—early in September, active measures were immediately undertaken to collect supplies from all parts of the country because of urgent war requirements. In an effort to reduce a shortage estimated at 20,000 ounces, an appeal to jewelers and for articles of jewelry containing the metal, was made and met with hearty response, the Government paying $105 per ounce through the United States Government Assay Office, New York. Donations from individuals were received by the Red Cross which received payment from the Government. The present U. S. Government fixed price —$105 per ounce is more than double the pre-war value of $45 per ounce, and is an inducement to increase production.

Annual output of platinum in this country is estimated by experts to be about 1,000 ounces—a by-product—that comes mainly from California and Oregon; 30,000 ounces were obtained from Colombia in 1917. Russia was in pre-war times the storehouse of the world with annual production of about 250,000 ounces.

QUICKSILVER.

Government requirements of quicksilver in September were reported to be increasing. Prices were unchanged, the Government paying $105 per flask of 75 pounds for pure metal and $100 per flask for recoveries. To other consumers $125 per flask of 75 pounds for single flasks or in lots of whatever size was the quotation throughout the month.

OLD METALS.

Old metals during the month past, were in active demand; specialties needed by the Government, such as cupro-nickel, manganese bronze, die-cast and monel scraps, were frequently called for. Aluminum in the regular list was in constant demand, prices advancing from 23 to 24c. for old cast and from 25 to 26c. for old sheet metal; new aluminum scrap was unchanged at 30c. Heavy lead was also in constant demand but the price remained and block tin pipe from 75c. to 70c. per pound. Heavy brass declined ½ to 14c. and brass turnings advanced an equal amount to 14c. Other items were unchanged.

WATERBURY AVERAGE

Lake Copper. Average for 1917—30.97. 1918—January, 23.50. February, 23.50. March, 23.50. April, 23.50. May, 23.50. June, 23.50. July, 26.00. August, 26.00. September, 26.00.

Brass Mill Spelter. Average for 1917—11.116. 1918—January, 9.60. February, 9.60. March, 9.40. April, 8.50. May, 8.95. June, 9.50. July, 10.30. August, 10.45. September, 11.20.

SEPTEMBER MOVEMENT IN METALS

	Highest.	Lowest.	Average.
Copper:			
Lake	*26.00	*26.00	*26.00
Electrolytic	*26.00	*26.00	*26.00
Casting	*26.00	*26.00	*26.00
‡Tin	.....	.....	.....
Lead	8.05	8.05	8.05
Spelter (brass special)	9.70	9.30	9.515
Antimony	14.12½	13.87½	13.934
Aluminum	†33.10	†33.10	†33.10
Quicksilver (per flask)	$125.00	$125.00	$125.00
Silver (cts. per oz.)	101⅛	101⅛	101⅛

*Government price. †Government price for carload lots. ‡Market nominal; no metal offering.

INQUIRIES AND OPPORTUNITIES

Under the directory of "Trade Wants" (published each month in the rear advertising pages), will be found a number of inquiries and opportunities which, if followed up, are a means of securing business. Our "Trade Want Directory" fills wants of all kinds, assists in the buying and selling of metals, machinery, foundry and platers' supplies, procures positions and secures capable assistants. See Want Ad. pages.

Metal Prices, October 14, 1918

NEW METALS

COPPER—DUTY FREE. PLATE, BAR, INGOT AND OLD COPPER. Manufactured 5 per centum.

Electrolytic, carload lots, nom. / Lake, carload lots, nominal...	Government price.	26
Casting, carload lots, nominal		26

TIN—Duty Free.

Straits of Malacca, carload lots	none offered

LEAD—Duty Pig, Bars and Old, 25%; pipe and sheets, 20%.

Pig lead, carload lots	8.05

SPELTER—Duty 15%.

Brass Special	9.00
Prime Western, carload lots	9.00

ALUMINUM—Duty. Crude, 2c. per lb. Plates, sheets, bars and rods, 3½c. per lb.

Small lots, f. o. b. factory		....
100-lb., f. o. b. factory		....
Ton lots, f. o. b. factory	Government price.	33.20

ANTIMONY—Duty 10%.

Cookson's, Hallet's or American	Nominal
Chinese, Japanese, Wah Chang WCC, brand spot...	13⅞

NICKEL—Duty Ingot, 10%. Sheet, strip and wire, 20% ad valorem.

Shot or Ingots	40 to 45c.

ELECTROLYTIC—5 cents per pound extra.

MANGANESE METAL	Nominal
MAGNESIUM METAL—Duty 20% ad valorem (100 lb. lots)	$1.90
BISMUTH—Duty free	3.50
CADIUM—Duty free ... nominal	1.50
CHROMIUM METAL—Duty free	.75
COBALT—97% pure	3.00
QUICKSILVER—Duty 10% per flask of 75 pounds	$130.00
PLATINUM—Duty free, per ounce	105.00
SILVER—Government assay—Duty free, per ounce	1.01⅛
GOLD—Duty free, per ounce	20.67

INGOT METALS

Silicon, Copper, 20%	according to quantity	50 to55
Phosphor Copper, guaranteed 15%	" "	59 to63
Phosphor Copper, guaranteed 10%	" "	57 to61
Manganese Copper, 30%, 2% Iron.	" "	65 to72
Phosphor Tin, guaranteed, 5%...	" "	1.25 to1.30
Phosphor Tin, no guarantee	" "	1.10 to1.15
Brass Ingot, Yellow	" "	18½to20½
Brass Ingot, Red	" "	27½to29½
Bronze Ingot	" "	27½to29½
Parsons Manganese Bronze Ingots	" "	30½to32
Manganese Bronze Castings	" "	40 to50
Manganese Bronze Ingots	" "	26 to30
Phosphor Bronze	" "	24 to30
Casting Aluminum Alloys	" "	38 to39

OLD METALS

Buying Prices.		Selling Prices.
24.00	Heavy Cut Copper	25.50
23.00	Copper Wire	25.00
21.00	Light Copper	23.00
23.00	Heavy Mach. Comp	25.50
14.50	Heavy Brass	16.50
11.00	Light Brass	13.50
14.25	No. 1 Yellow Brass Turning	14.25
21.50 to 22.50	No. 1 Comp. Turnings	23.00 to 25.00
7.00	Heavy Lead	7.25
5.25	Zinc Scrap	5.70
10.00 to 13.00	Scrap Aluminum Turnings	11.00 to 14.00
19.00 to 21.50	Scrap Aluminum, cast alloyed	21.00 to 23.00
26.00 to 28.00	Scrap Aluminum, sheet (new)	28.00 to 30.00
55.00	No. 1 Pewter	60.00
22.00 to 23.00	Old Nickel anodes	25.00 to 26.00
30.00 to 32.00	Old Nickel	34.00 to 36.00

Prices of Copper Sheet

Since the September number of THE METAL INDUSTRY was issued the War Industries Board has assumed control of the distribution of the output of this country's brass and copper mills. In view of this there is no longer what may be termed an open market and all published and quoted prices have been withdrawn. The matter of price on future business will be subject to negotiation between buyer and seller when the War Industries Board has issued permit to manufacture the particular lot of material required.

In view of this it is advisable for us to omit printing prices on such items as are covered by the orders of the War Industries Board until such a time as normal conditions again prevail in this line of business.

Metal Prices, October 14, 1918

DUE TO THE ASSUMPTION OF THE DISTRIBUTION OF BRASS AND COPPER BY THE WAR INDUSTRIES BOARD, ALL PUBLISHED AND QUOTED PRICES FOR THESE METALS HAVE BEEN WITHDRAWN FOR THE DURATION OF THE WAR.

Metal Prices, October 14, 1918

ZINC SHEET

Duty, sheet, 15%. Cents per lb.

Carload lots, standard sizes and gauges, at mill, 15c. basis, less 8%

Casks, jobbers' prices.................................17c.

Open casks, jobbers' prices.............................17½c.

The above mill prices have been fixed by the United States Government, applying to civilian population of the United States and allied governments.

WAR SERVICE ASSOCIATION OF SECONDARY ALUMINUM SMELTERS

Announcement is made of the formation of a society of the above title, the first meeting towards that end having been held on Thursday, September 26, 1918, at Washington, D. C. The secondary aluminum smelters met at the call of the War Industries Board and at the suggestion of Pope Yeatman, Director of the Metals Section of the board, they organized a War Service Association, the membership to be confined exclusively to smelters.

The principal object of the organization is to aid the Government's war agencies in the conservation of aluminum and in securing harmonious support of the industry for all regulations made by the Government.

The following officers and executives were elected:

President, B. Randolph, of William F. Jobbins, Inc., Aurora, Ill.

Vice-president, L. M. Brile, United Smelting and Aluminum Company, New Haven, Conn.

Secretary-treasurer, C. H. Lipschitz, 150 Lafayette street, New York.

Executives, Joseph Silliman, Michigan Smelting & Refining Company, Detroit, Mich.; Walter Weil, National Smelting Company, Cleveland, Ohio, and S. M. Fox, Great Western Smelting & Refining Company, Chicago, Ill.

The offices of the association will be at 150 Lafayette street, New York.

ALUMINUM SHEET, ROD AND WIRE

Sheet Aluminum, outside market contract base price, 42.40c. per pound.

FLAT SHEET

Gauge		1 Ton Lots	15 Ton Lots	50 Ton Lots
		Price in Cents per Lb.		
Nos. 18 and heavier....	3" to 60"	42.40	42.20	42.00
Nos. 19 and 20.........	3" to 60"	43.50	43.30	43.10
Nos. 21 to 24, incl...	3" to 30"	45.80	45.60	45.40
	30" to 48"	48.00	47.80	47.60
	48" to 60"	51.40	51.20	51.00
Nos. 25 and 26......	3" to 30"	49.20	49.00	48.80
	30" to 48"	51.40	51.20	51,00
No. 27.............	3" to 30"	50.30	50.10	49.90
	30" to 48"	53.70	53.50	53.30
No. 28.............	3" to 30"	52.50	52.30	52.10
	30" to 48"	55.90	55.70	55.50
No. 29.............	3" to 30"	55.90	55.70	55.50
	30" to 48"	60.40	60.20	60.00
No. 30................	3" to 30"	58.20	58.00	57.80

ROD.

B. & S. Gauge.

¾" to 1" Advancing by 32nds }
1" to ⅝" " " 16ths } 98% rolled, 43.10 cents per lb.
2⅝" to 3½" " " 8ths }

⅜" to ¾", 98% rolled and drawn..........48.80 cents per lb.

WIRE.

Definition: Round—less than ⅜" diameter. Other shapes—less than ⅜" greatest diameter.

B. & S. Gauge.	Spools.	Price in Cents Per Lb. On Spools.	In Coils.
Nos. 2 to 10, inclusive.......	50 lb.	$.465	$.437
Nos. 11 and 12...............	50 lb.	.499	.465
Nos. 13 and 14...............	35 lb.	.533	.493
Nos. 15 and 16...............	20 lb.	.611	.549
Nos. 17 and 18...............	20 lb.	.689	.606
Nos. 19 and 20...............	10 lb.	.714	.718
No. 21.......................	10 lb.	.815	.803
No. 22.......................	10 lb.	1.050	.915
No. 23.......................	10 lb.	1.185	1.028
No. 24.......................	5 or 2 lb.	1.421	....
No. 25.......................	5 or 2 lb.	1.646	....
No. 26.......................	5 or 2 lb.	1.928	....
No. 27.......................	1 lb.	2.321	....
No. 28.......................	1 lb.	2.771	....
No. 29.......................	½ lb.	3.840	....
No. 30.......................	½ lb.	5.021	....

BLOCK TIN SHEET AND BRITANNIA METAL

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker. 100 lbs. or more, 10c. over Pig Tin. 50 to 100 lbs., 15c. over 25 to 50 lbs., 17c. over, less than 25 lbs., 25c. over.

No. 1 Britannia—18" wide or less. No. 26 B. & S. Gauge or thicker, 500 lbs. or over at N. Y. tin price, 100 lbs. or more, 5c. over Pig Tin. 50 to 100 lbs., 12c. over, 25 to 50 lbs., 15c. over, less than 25 lbs., 25c. over.

Above prices f. o. b. mill.

Prices on wider or thinner metal on request.

LEAD FOIL

Base price—5.75 cents per lb.

TIN FOIL

Base price—No quotation.

PLATERS METALS

Nickel silver platers' bars dependent on the percentage of nickel, quantity and general character of the order.

Platers' metal, so called, is very thin metal not made by the larger mills and for which prices are quoted on application to the manufacturer.

SILVER SHEET

Rolled silver anodes .999 fine are quoted at from $1.03 to $1.05 per Troy ounce, depending upon quantity.

NICKEL ANODES

85 to 87%	purity..............................	.55c.	per lb.
90 to 92%	"	.57½c.	" "
95 to 97%	"	.60c.	" "

Supply Prices, October 14, 1918

CHEMICALS

Acid—		
Boric (Boracic) Crystals	lb.	.25
Hydrochloric (Muriatic) Com., 18 deg	lb.	.08
Hydrochloric, C. P., 22 deg	lb.	.16
Hydrofluoric, 30%	lb.	.40
Nitric, 36 deg	lb.	—
Nitric, 42 deg	lb.	—
Sulphuric, 66 deg	lb.	.08
Alcohol—		
Denatured	gal.	1.00
Alum—		
Lump	lb.	—
Powdered	lb.	—
Aluminum sulphate, iron free	lb.	.15
Aluminum chloride solution	lb.	.16
Ammonium—		
Sulphate, tech.	lb.	.10
Sulphocyanide	lb.	—
Arsenic, white	lb.	.25
Argols, white, see Cream of Tartar	lb.	.80
Asphaltum	lb.	.35
Benzol, pure	gal.	1.00
Blue Vitriol, see Copper Sulphate.		
Borax Crystals (Sodium Biborate)	lb.	.15
Calcium Carbonate (Precipitated Chalk)	lb.	.15
Carbon Bisulphide	lb.	.20
Chrome Green	lb.	—
Cobalt Chloride	lb.	—
Copper—		
Acetate (Verdigris)	lb.	—
Carbonate	lb.	.45
Cyanide	lb.	.65
Sulphate	lb.	.15
Copperas (Iron Sulphate)	lb.	.06
Corrosive Sublimate, see Mercury Bichloride.		
Cream of Tartar, Crystals (Potassium bitartrate)	lb.	.80
Crocus	lb.	.10
Dextrin	lb.	.25
Emery Flour	lb.	.10
Flint, powdered	ton	—
Fluor-spar (Calcic fluoride)	ton	—
Fusel Oil	gal.	—
Gold Chloride	oz.	12.00
Gum—		
Sandarac	lb.	—
Shellac	lb.	—
Iron Sulphate, see Copperas	lb.	.06
Lead Acetate (Sugar of Lead)	lb.	—
Yellow Oxide (Litharge)	lb.	.20
Mercury Bichloride (Corrosive Sublimate)	lb.	—
Nickel—		
Carbonate Dry	lb.	.80
Chloride	lb.	.70
Salts, single bbl	lb.	.16
Salts, double bbl	lb.	.14
Paraffin	lb.	.25
Phosphorus—Duty free, according to quality		60-80c.
Potash, Caustic (Potassium Hydrate)	lb.	—
Lump	lb.	—
Potassium Bichromate	lb.	—
Carbonate, 96-98%	lb.	1.25
Cyanide, 98-99½%	lb.	—
Sulphocyanide	lb.	—
Pumice, ground	lb.	—
Quartz, powdered	ton	—
Official	oz.	.73⅝
Rosin	lb.	.10
Rouge, nickel	lb.	.45
Silver and gold	lb.	.60
Sal Ammoniac (Ammonium Chloride)	lb.	.30
Sal Soda	lb.	.05
Silver Chloride, dry	oz.	—
Cyanide	oz.	—
Nitrate, 100 ounce lots	oz.	.6337
Soda Ash, 58%	lb.	.08
Sodium—		
Biborate, see Borax	lb.	.15
Bisulphite	lb.	.15
Cyanide	lb.	.30
Hydrate (Caustic Soda)	lb.	.15
Hyposulphite	lb.	.08
Nitrate, tech.	lb.	.12
Phosphate	lb.	.14
Silicate (Water Glass)	lb.	.08
Soot, Calcined	lb.	—
Sugar of Lead, see Lead Acetate	lb.	.35
Sulphur (Brimstone)	lb.	.10
Tin, Chloride	lb.	.75
Tripoli Composition	lb.	.06
Verdigris, see Copper Acetate	lb.	—
Water Glass, see Sodium Silicate	lb.	.05
Wax—		
Bees, white ref. bleached	lb.	—
Yellow	lb.	.60
Whiting	lb.	.05
Zinc, Carbonate	lb.	.30
Chloride	lb.	.35
Cyanide	lb.	.50
Sulphate	lb.	.12

COTTON BUFFS

Open buffs, per 100 sections (nominal).

12 inch	20 ply	64/68	cloth	base,	$77.50
14 "	20 "	64/68	"	"	102.50
12 "	20 "	84/92	"	"	93.00
14 "	20 "	84/92	"	"	120.60

Sewed buffs per pound.

Bleached and unbleached	"	.65
Colored	"	.55

FELT WHEELS

White Spanish—

Diameter	Thickness	Price	
6 to 20 inches, inc.	½ inch or under	$4.05	per lb.
6 to 20 inches, inc.	⅝ inch to ⅞ inch, inc.	3.45	"
6 to 9⅞ inches, inc.	1 inch to 3 inches, inc.	3.25	"
10 to 16 inches, inc.	1 inch to 3 inches, inc.	3.15	"
18 to 20 inches, inc.	1 inch to 3 inches, inc.	3.25	"
6 to 20 inches, inc.	over 3 inches	3.25	"

Grey Mexican—

Diameter	Thickness	Price	
6 to 20 inches, inc.	½ inch or under	$3.95	per lb.
5 to 20 inches, inc.	⅝ inch to ⅞ inch, inc	3.35	"
6 to 9⅞ inches, inc.	1 inch to 3 inches, inc.	3.15	"
10 to 16 inches, inc.	1 inch to 3 inches, inc.	3.05	"
18 to 20 inches, inc.	1 inch to 3 inches, inc.	3.15	"
6 to 20 inches, inc.	over 3 inches	3.15	"